THE

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## INCANDESCENT LAMPS.

THE subject of incandescent lamp manufacture is attracting considerable attention at the present moment, and this interest will be maintained long after the competition in the sale of lamps has set in. It is expected at the expiry of the Edison patent, which takes place on the tenth of next month, that anyone will have the power to make lamps; to all intents and purposes this view is correct. At the same time there are one or two facts in connection with the making of lamps which it is well to bear in mind at the present moment. Lord Justice Fry upheld the Edison patent on the grounds of the combination of lamp and filament. This decision effectually stopped the making of lamps of any kind until the expiry of the patent. But at the present juncture the Edison-Swan Company are not making an incandescent lamp according to Edison's specification. Certainly there is what the Court considered the combination; but the filament is made of parchmentised thread, and for this Mr. Swan took out a patent sometime subsequent to the issue of Edison's English patent. This patent has not yet expired and will not do so until December 2nd, 1894. It is a moot point, therefore, whether the manufacture of a lamp similar to that now made by the Edison-Swan Company, will not prove an infringement of Mr. Swan's patent. The Edison-Swan Company express no opinion as to whether or not the matter is likely to go before the Courts in the event of infringement. It is clear that there is sufficient grounds for an action, but taking all things into consideration one is inclined to think that the Edison and Swan Company would hesitate to interfere with makers who are disposed to use the parchmentised thread as a filament. When a patent has only about thirteen months to run it would seem hardly worth while entering into litigation in order to afford it protection for such a short time. This, of course, may not be sound Patent Law, for it might be assumed that if a patent were good it would be defended to the last.

The Edison-Swan Company are, however, in a difficult position. They are making a filament under a patent which was taken out subsequent to Edison's specification; but it is doubtful whether in the face of this patent they could substantiate their case in open Court. One thing is perfectly clear, if anyone else but the Edison-Swan Company had attempted to evade the master patent by substituting a parchmentised thread for a vegetable fibre, they would have been assuredly prevented. Our opinion is that this claim will not be contested. But there are other details in the lamp which seem to us to be clearly outside the patent which expires next month. The most important is the method of jointing the filament to the carbon which is at present used by the Edison-Swan Company. This is practically based on the specification of Swan, which was lodged on September 29th, 1881. The text of the patent is somewhat as follows:—"This in-

vention relates to a method of producing by means of electrical heating, a coating or deposit of carbon over the junction of the metallic socket and the carbon filament inserted in it. For this purpose after the ends of the filament are clamped in their places, it is inserted in an electrotype bath, and a coating of copper is deposited all over it, except immediately against the clamps. After removal from the bath, the filament is immersed in hydrocarbon liquid or vapour, and a current is sent through it, which raises the uncoated portions to redness, and causes a deposit thereon of solid carbon, which welds together the filament and the socket." Although this process is somewhat erroneously called the "flashing process," it is very similar to the Cheesebrough method of flashing the filament. It is obvious that this is a patent of extreme value; at present we know of no other means which can compare with this system of obtaining an almost perfect joint. As this patent will not expire until September 29th, 1895, we may assume that the Edison Company will be disposed to contest its value, if necessary. In addition to the foregoing undoubted advantages possessed by the Edison Company, they still retain valuable patents for holders and other details. These are some of the things which convince us that the Edison-Swan Company are fairly well equipped for the fight which is to take place.

There can be no denying that we have arrived, with the cheapening of electric lamps, at a most important epoch in the history of electric lighting. Lamps at 3s. 9d., oftener 4s. 6d. to the small consumer, formed a most serious objection to the use of electric lighting. A reduction, therefore, to 1s. 6d. or 1s. 9d. is an important consideration from a consumer's point of view. The decrease in the cost of Edison-Swan lamps came none too soon. Indeed, it has been said that fewer consumers would have been alienated if there had been more disposition to make concessions. While there may be a certain amount of justice in this, it must be admitted that though the Edison and Swan Company have rigidly maintained their monopoly, their gains have not been great. One of the effects of the Edison patent expiry will be the enormous number of cheap lamps that will be thrown on the market. The supply will far exceed the demand, and there will be a consequent temporary depression. It is expected that there will be considerable consignments of lamps from Germany, and if report speaks truly, large numbers of these will be utterly unfit for use. It will be, no doubt, very tempting to purchase lamps at 6d. and 9d. each, at which price many will be offered, but we can only urge the utmost caution in this respect. We do not say avoid absolutely cheap lamps, because until they have been used their capabilities will be unknown. Without desiring to appear too pessimistic, however, we must confess to grave doubts as to the efficiency of many cheap foreign-made lamps. There have been some extraordinary illusions rife as to what we are to gain from the reduction in price. It has been argued with more or less reason that cheapening lamps was the only thing necessary to develop electric lighting. While recognising that lamps are a very important factor in lighting, it is a mere fallacy to suppose because the Edison patents lapse next month that electricity as an illuminant is to become universal. The decrease in the cost of electric supply is a matter ten times more important than the price of lamps, and this is a matter that has been overlooked, apparently, by the future purveyors of lamps. We grant that the use of electric lighting is advancing day by day, but the most enthusiastic advocate could not say that it is going ahead rapidly. We repeat that the universal use of electricity is more dependent on other factors than the lowering of the price of lamps. Less expensive lamps will assist, no doubt, and many a person may be induced to adopt electric lighting solely on account of paying less for lamps, but in many cases the cost of lamps even at the old prices forms a small proportion of the cost of a complete system of electric lighting.

We hear from various sources that factories are being installed in England with plant capable of turning out a million lamps per annum. This is, of course, mere hearsay, and must be taken for what it is worth. It is obvious that it is exaggeration, for such an annual turn-out would mean over 3,000 lamps a day. We should fairly doubt the sanity of capitalists who at present laid down plant capable of dealing with this enormous output. Looking at facts squarely in the face, we are not favourably impressed with the commotion which has arisen from the impending competition in the sale of lamps. Competition may result in some permanent advantage to consumers, but we are not sanguine about the prospects of those who are depending largely on this new development. It is said that two or three large firms are making preparations on a somewhat lavish scale for the production of lamps. We sincerely hope these manufacturers have considered the position of things. It is not to be supposed that there will be much more than a normal demand for lamps, and if enormous numbers are made to meet the slightly enhanced demand, a serious deadlock must ensue. When the central stations now in course of erection are completed many more lamps will be used, but the increase will be steady, and the manufacture of cheap lamps will not force matters forward very much. There is also another matter which we hope has been carefully considered. From whence are the skilled workmen to come? Skilled labour of a very high standard is required to make lamps successfully, and a considerable period must be spent in producing an efficient workman. It would be idle to suggest that the new factories have not taken this into account, but it would be interesting to know where the skilled workers are coming from. The quality of the lamps will be a very important factor in the competition. We are absolutely without information as to the capabilities of the new English lamps, and until they have had a fair trial, we cannot profess to judge of their merits. One thing is quite certain, however, cheap and inferior lamps will not be used for any length of time. They may be tried, but if found wanting they will be gradually pushed on one side by better and it may be more expensive lamps. It has been argued that cheap and somewhat inefficient lamps at low prices may be run successfully on circuits at a higher voltage than that for which they were made. This may be very well in theory, but there would be too much variation in metropolitan electric supply to allow of this being done. Our opinion is that the good lamps will be the only ones to survive, and in this respect we imagine that the Edison & Swan Company will be able to hold its own against its younger rivals. Lengthened experience, good lamps, and organisation, must go for something in a competition of this nature. Lamps should be made as cheaply at Ponder's End as elsewhere, and if the hitherto good

quality is maintained they will be hard to beat. Naturally there will be a considerable falling away of old customers anxious to try new lamps, but these seceders will judge all new lamps by the standard of the old, and, as we have before said, they will need to be good lamps which are superior to the old ones. The Edison-Swan Company possess many minor patents which will have to be considered. Their rights in these have been tacitly admitted, and at the present moment they are obtaining fair royalties on holders and other concomitants necessary in a good lamp. We imagine that the conditions of supply in the metropolis will sorely try some of the new lamps, because it is reckoned that the fluctuations that one too often sees on the circuits are enough to shorten the life of lamps by 200 hours.

Mr. Elieson's Storage Battery System.

Judging from our American contemporaries, Mr. Elieson appears to have been successful in his experiments with storage batteries for traction purposes. The tests seem to be practical enough, and were carried out under the worst possible conditions. A short length of line, about two miles long, was laid down in the town of Mount Vernon for the purpose of enabling Mr. Elieson to run a car with his accumulators. The track was laid directly on the road surface, there was no attempt at grading, and the curves were numerous. In spite of these and other difficulties, however, Mr. Elieson has kept a car running from July 31st to the present time without a single hitch. The town authorities, for whose satisfaction the trials have been made, are thoroughly pleased with the results, and it remains to be seen whether Mr. Elieson is able to convince American financiers of the value of his system. Bearing in mind the lamentable failures that have hitherto attended battery cars, one is inclined to be sceptical of the possibilities of accumulators for traction purposes, although Mr. Elieson seems to achieved some important results. There is no doubt that accumulators have been vastly improved of late, still there are objections which have not yet been overcome to the satisfaction of tramway engineers. In spite of this we are full of hope for the future of accumulators, and we are sanguine of seeing the transit problem overcome in a great measure by storage batteries.

Mysterious Fires.

During a recent visit to a country hotel which was lighted by incandescent lamps. Prof. John Trowbridge relates that a thunder-storm occurred, and he noticed that the lamps blinked at every discharge of lightning, although the interval which elapsed between the blinking and the peals of thunder, showed that the storm was somewhat remote. The effect was doubtless due to induction, produced by the surging of the lightning discharges. On the occasion of a heavy discharge, the lamps were extinguished, although no fuse was burned; this provided an opportunity for an attendant to discover that a jet of gas from a pin-hole leakage in the gas fixtures had become ignited (doubtless by a minute electric spark) and the flame was impinging upon some adjacent wood-work. The discovery averted what would have been, perhaps, a serious and mysterious conflagration. The moral of the story is, of course, to be found in the reflection that had the electric light wires not been carried along the gas fixtures, as they were in this case, the ignition would probably not have occurred, This practice is fraught with danger, for if there is a leakage of gas (and what gas fixtures do not leak?) at the joints of the pipes or through a sand-hole or other flaw in the casting, then tiny electric sparks arising through resonance effects or from the passage to earth of an electric charge brought into the building by the wires, may, if they happen to form in contiguity to the leak, readily ignite the escaping gas without being discovered in time to prevent disaster. If people will cling to their gas when they lay down an electric lighting system, then it behoves the electrical engineer who superintends the work to see that the wires and the pipes are never contiguous, for no lighting guard or protector yet invented, can ensure that minute sparks, due in some cases to resonance effects, may not arise.

Wasted Energy.

A consideration of the waste of energy which is continually going on is too appalling for anyone unless he be a newspaper scientist. A matter that has been sorely troubling an American writer is the enormous waste of energy which occurs in the testing of dynamo machinery. It seems, no doubt, at the first blush that the method of testing with water, platinoid, and other resistances, is a most extravagant one. To charge accumulators with part of the wasted energy for the purpose of operating motors seems rational enough, but whether it would be expedient in every case is quite an open question. The initial cost of a battery of accumulators would be heavy, but in many cases it would be more than justified. This method, of course, would only be useful in the case of large machines running for long periods, say for 24 and 48 hours, and for other long tests. There would be little advantage gained from the employment of accumulators where machines were only run for an hour or so. We are under the impression that batteries for resistance purposes have been used in English workshops, but we are not absolutely certain. It is significant that in one of the large American shops the energy dissipated uselessly in the form of heat and chemical decomposition of water during testing operations, is over 8,000 kw. hours per week.

Mr. Tesla's Lecture at the Congress.

Mr. Tesla has succeeded in constructing a new, and what seems to be a perfect, mechanism for producing electrical oscillations of a constant period, independent of the driving force, of frictional losses, and the load. At his lecture on "Mechanical and Electrical Oscillators," at Chicago, he mentioned, among other things, that he was able, by this new apparatus, to produce an alternating current in which the E.M.F. of the impulses in one direction preponderates over that of those in the other, so that there is produced the effect of a direct current. In fact, he expressed the hope that these currents would be capable of application in many instances, serving as direct currents. The New York *Electrical Engineer* describes the machine, but only very scantily. The principle involved in this preponderating E.M.F. is explained by Mr. Tesla as follows: suppose a conductor is moved into the magnetic field and then suddenly withdrawn; if the current is not retarded, then the work performed will be a mere fractional one, but, if the current is retarded, then the magnetic field acts as a spring. Imagine that the motion of the conductor is arrested by the current generated, and, at the instant when it stops, there is still the maximum current flowing in the conductor; then this current will, according to Lenz's law, drive the conductor out of the field again, and, if the conductor had no resistance, then it would leave the field with the velocity at which it entered it. Now, it is clear that if, instead of simply depending on the current to drive the conductor out of the field, a mechanically applied force is so timed that it helps the conductor to get out of the field, then it might leave the field with a higher velocity than that at which it entered it, and thus one impulse is made to preponderate in E.M.F. over the other. With a current of this nature Mr. Tesla energised magnets strongly and performed many interesting experiments, bearing out the fact that one of the current impulses preponderates. We hope to see more of Mr. Tesla's apparatus when he next honours us by bringing it to England.

## MULTIPHASE MOTORS AND SYSTEMS.

The Electrical Congress at Chicago one would have supposed would have brought out something of interest regarding alternating current motors in general, and multiphase motors in particular.

It is a remarkable fact, however, that the official programme showed that no papers on the subject were to be read. A glance over the work actually accomplished by, and the papers actually read and discussed at, the Congress also shows that American electrical engineers declined to contribute to the discussions on multiphase motors, and in fact on almost all subjects of trade interest they were dumb. European electrical engineers were conspicuous by their absence. The usual professors were all there engaged in their usual kind of kite flying papers and discussions. Papers by many of the learned professors are occasionally valuable and instructive, but are generally only entertaining, and are never of that kind which it is desirable to have at such a meeting as a great International Congress. Very few of the men actually engaged in electrical engineering practice were present; the men to whom the world owe the practical development of the dynamo, the electromotor, the transformer, the arc lamp, the incandescent lamp, and many other important inventions, were not there. Yet these are the men who could have filled up the programme with interesting subjects. In their absence the professors got up a discussion on multiphase motors among themselves. Dr. Louis Duncan opened the discussion by recounting the advantages of multiphase motors; this was followed by what must have been a rather tiresome and somewhat showmanlike description of the Tesla multiphase system as exhibited in the Electricity Building. A hard-headed engineer from California then came forward and remarked that notwithstanding all that had been said about the perfection and beauty of their systems and machines for long distance transmission of power, none of them had established the commercial success of their schemes. "Only a year ago," says this engineer, "the first contract for a definite transmission of power was closed and to-day the superintendent of the mine in which the installation was made is looking at his burned out field coils, after the generator has been in operation for less than thirteen days."

The discussions which followed were not much better than twaddle; Prof. S. P. Thompson giving his opinion that multiphase motors would finally be abandoned in favour of single-phase motors.

Only once did the discussion become interesting, when Prof. Geo. Forbes intimated that it had been decided to use two-phase alternating currents for transmission and distribution of power from Niagara Falls. The arguments in favour of such a system are indisputable; it combines all the advantages of both the alternating and continuous current systems, and to a very great extent eliminates the faults of both.

The discussion then wandered off into the subject of frequency, and it was generally agreed that low frequency was desirable for motor work, but that for lighting, a limit is reached at 50 per second as the minimum.

We have already referred in our columns to this matter of frequency, and think that we have given good reason for fixing the lowest frequency at 60 and the highest at 72. The fixing upon one frequency for all alternating current work in public supplies is a matter requiring very urgent attention. Both in America and on this side, electrical engineering progress is much hindered by the senseless employment of many different frequencies. In London we have a different frequency in the several installations supplying alternating currents; we have 65, 80, 100 and 133. This is lamentable, and leads to no end of trouble and unnecessary expense; so much so, that the adoption of one common frequency must, sooner or later, be made compulsory by some means. We believe the losses at the higher frequency will compel those supplying it to lower it to one-half at no distant date.

The resolution to adopt multiphase alternating currents at Niagara must be very satisfactory to those engineers who have worked upon this subject; they may yet hope to reap some benefits from their labours. Hitherto, in England, the public have been guided in their electrical engineering projects by two or three professors who have stereotyped plans for distribution of electricity, precluding the introduction of improvements. Still, there can be no doubt that an improved system will find its way into favour, and if the multiphase system is a success at Niagara, it is likely to be adopted here in some places.

Prof. Forbes pointed out in his remarks on the Niagara scheme that two-phase current supply can be used for all alternating current work, whether single-phase or multiphase, and two-phase currents can be easily converted into continuous currents and *vice versâ*; and he also stated the remarkable fact that two-phase alternators are cheaper than single-phase alternators for equal outputs.

Two-phase distribution of alternating currents has been advocated by Mr. Rankin Kennedy repeatedly in our columns. All the advantages have, from time to time, been set forth in communications to this journal; and a very excellent little treatise on the subject has been offered, for some time, from the pen of M. Hospitalier. We wonder why the subject has not attracted more attention here, and that it has not been more freely discussed among our leading practical electrical engineers.

## NOTE ON ALTERNATING CURRENTS.

By ARTHUR WHITWELL, M.A.

When a varying E.M.F. is impressed on a circuit having self-induction it is usual in finding the resulting current to employ the equation $E = C R + L \frac{d C}{d t}$, neglecting the remaining terms. The full equation may be written:

$$E = C R + L \frac{d C}{d t} + M \frac{d^2 C}{d t^2} + N \frac{d^3 C}{d t^3} + \&c.$$

When the impressed E.M.F. is a sine function, $E \sin p t^1$, we may find the current from the last equation and see the effect of the third and fourth terms as follows:—

Assume the resulting current to be $= C \sin p t$ where $p = \frac{2\pi}{T}$, T being the period, then $\frac{d C}{d t} = p \cos p t$, $\frac{d^2 C}{d t^2}$ $= - p^2 C \sin p t$, $\frac{d^3 C}{d t^3} = -p^3 C \cos p t$, and the impressed E.M.F. must be $= C R \sin p t + L p C \cos p t - M p^2 C \sin p t - N p^3 C \cos p t$

$$= C \sqrt{(R - p^2 M)^2 + (L p - p^3 N)^2} \sin (p t + \theta)$$

where $$\tan \theta = \frac{L p - p^3 N}{R - p^2 M},$$

making

$$E = C \sqrt{(R - p^2 M)^2 + (L p - p^3 N)^2}$$

and

$$p t^1 = p t + \theta.$$

We see that an impressed E.M.F. of $E \sin p t^1$ will give a current of

$$\frac{E}{\sqrt{(R - p^2 M)^2 + (L p - p^3 N)^2}} \sin (p t^1 - \theta).$$

From this we see that the effect of taking the third term into account is apparently to diminish the ohmic resistance by an amount inversely proportional to the square of the period, and the effect of the fourth term is to apparently diminish the self-induction in a similar manner, for the second term under the root may be written $p^2 (L - p^2 N)^2$. As both the ohmic resistance and self-induction are diminished the impedance is diminished and the current is increased; the angle of lag is apparently diminished. The effect, then, of taking the fuller equation is to give a greater current and less angle of lag.

## THE SCIENTIFIC STUDY OF ARC LAMPS.

By RANKIN KENNEDY.

The arc lamp first of all was the means of interesting the public in electric lighting, and was for many years prior to the invention and perfection of the dynamo, the subject of much study, so that fairly good regulators for working the arc had been prepared some considerable time before the generator required to work it commercially was invented.

These old regulators contain the germs from which have sprung all existing lamp regulators now in use; the progress made during the past fifteen or sixteen years has not been due to any wonderful discoveries, but to clever improvements. That the march of improvement in arc lamps is still going on, is very forcibly demonstrated by the fact that two or three of the leading arc lamp makers in this country have quite recently abandoned their hitherto standard lamps and introduced new ones, and one eminent lamp designer is still making changes in his regulator, the latest batch of lamps sent out having some improvement upon the previous batch.

The fact is that the arc lamp is only beginning to be understood by those who have been in the arc lamp business, and those outside of that business have only a very superficial knowledge of the subject. There is no lack of arc lamps, their name is legion. "Many are called but few are chosen." Almost every electrical engineer has at some time or another come across the man with an arc lamp which burned well under some conditions, generally a man who professed his ignorance of electricity; the lamp, mostly, is an adaptation of some well known simple arc lamp mechanism; the mechanism is usually ingenious, and a well placed dashpot plays the principal part in regulating the lamp. This is how lamps are multiplied, but not how they are improved.

Examined critically, such lamps, generally speaking, turn out to be fit only for use under one set of conditions, and it is apparent that their designers are in happy ignorance of the real difficulties met with in getting out an arc lamp to compete with those already passed the critical stages. These remarks are made with a view to impress on the readers of this study of arc lamps at the very outset the great fact that every new lamp introduced does not contain a new

Fig. 1.

discovery in arc lamps. Nevertheless, a very good invention often results from a different combination of old things. Now, arc lamp regulators are eminently combinations of old things, and as there are a considerable number of different things in an arc lamp regulator, the different combinations are correspondingly great. In this study we could not attempt to glance at all the different combinations, we must confine ourselves to the essential things in an arc lamp, and illustrate the combinations by a few well known successful ones.

In all arc lamps alike there are two devices, first a mechanical device, and second an electro-magnetic device, both combined to regulate the arc; the mechanical devices are many, the electro-magnetic devices are few. We shall study first each separately, and then the combinations, and thereby we shall avoid much confusion.

To begin at the beginning, fig. 1, we have two rods of carbon, end to end, and two ends of wires, + and −, coming from an electric supply. Now, the problem is to bring the two rods together, then separate them about an eighth of an inch, and then move them towards each other exactly at the rate they burn away, so that the distance by which they are separated, remains constant, and practically neither increases nor decreases during the flow of current across the arc.

We may fix one carbon and move the other, or we may move both to and from each other, and a mechanician would immediately perceive that the carbons could be moved by the following devices:—1. A Screw and nut. 2. A rack and pinion. 3. A cord or strap and pulley. 4. A friction clutch.

An electrician might propose a purely electrical device such as fig. 2, where the two carbon points are *a*, *b*; *b* is fixed;

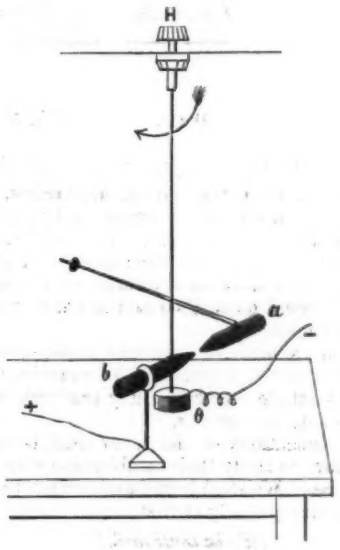



Fig. 2.

*a* swings on a torsion wire, and is connected to the electric supply through a wire dipping into a mercury cup, the + wire goes to the fixed carbon; by means of the milled head, H, we could bring the points together and allow the current to pass. When current passed the two points would repel each other and form an arc between them; the carbon, *a*, would swing round until the torsion of the wire equalled the repulsion of the carbons, and thus the arc would be struck; as the carbons burned away they would require to be fed towards each other by gently moving the milled head, H, in the direction of the arrow.

The screw can be applied in three different ways to feed the carbons towards each other. In fig. 3 the one carbon is fixed and the other is fed forward by one screw, S, which can be turned by hand wheel, H. By these means it would be easy to bring the carbons together and part them again, and also by watching the arc it would be easy to keep the length of it constant simply by turning the screw.

In fig. 4 the arrangement has two screws, one cut right hand and the other cut left hand; the one works the positive carbon down, the other works the negative up, so that the light is focus keeping.

With alternating currents both carbons consume at same rate; the light would, therefore, by accurately focus keeping, if both screws were cut same pitch.

With continuous currents, the upper or + carbon burns away at about double the rate of the lower or negative carbon, the light to be focus keeping would require, therefore, to have the carbons fed, the upper or positive at twice the rate of the lower or negative carbon; for this purpose the one screw is cut twice the pitch of the other.

Primitive as this device is, yet nearly all the projectors

and large search lights in the world are regulated by this simple mechanism, controlled by the hand and eye of the operator.

In fig. 5 an Archimedian screw and nut of long pitch is used, the lower carbon is fixed, the upper is attached directly to the screw, as also is a weight, *w*. Now, if we prevent either the nut or the screw from revolving, the upper carbon

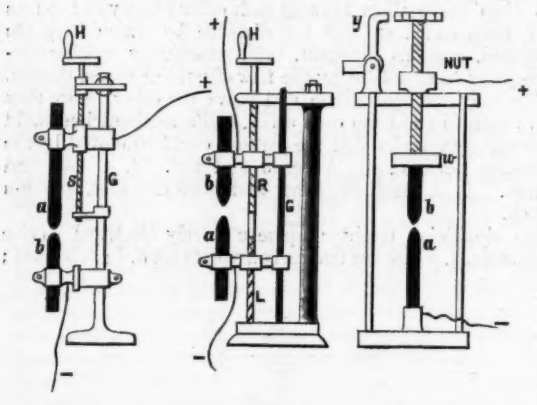



Fig. 3. Fig 4. Fig. 5.

cannot approach the lower one, but if we allow either nut or screw to revolve, then the carbon approaches, and it is obviously to regulate the rate of approach by regulating the revolutions of the screw or nut. The weight, *w*, is the power to move the screw or nut; a trigger, *y*, could be arranged to stop and start the revolution of the screw, and a similar trigger could be applied to the nut if the nut were made the revolving part.

Actual lamps are made, or have been made, embodying the screw devices illustrated in figs. 4 and 5 for moving the carbons.

In our next article we shall study the rack and pinion devices for moving the carbons.

The three applications of the screw shall be again taken up when we have to study their combination with the electro-magnetic devices. We shall better understand the parts by considering them separately at first.

*(To be continued.)*

## BOILERS AT THE WORLD'S FAIR.

### II.

There remain four more types of boiler to be described, says Mr. York, in his second paper in *Cassier's Magazine*, and they are all of the straight inclined water tube variety, like the Root boiler, with front and rear water heads and overhead drums for steam or for water and steam.

The National boiler has the general appearance of the Babcock. Any tube may be removed without disturbing the header in which it is expanded, and, also, any header can be removed with its tubes, there being, apparently, four tubes in each header, and the various headers are connected one to the other, above and below it, by short tubes expanded in.

The Fell boiler differs from the other inclined water-tube boilers in having no horizontal longitudinally placed steam drums, the drums used being placed parallel with the water tubes. The steam from the upper end of these drums, which are really only larger water tubes, passes on its way to the transversely placed steam drum, *viâ* horizontal superheating or drying tubes. The Fell boiler is supported by saddles under the mud drum, not suspended from above, and by a roller on an arch over the fire-doors at the front.

The "Gill" is one of the latest designs in water tube boilers. Its headers contain each five tubes, and these are so arranged that when put together, the tubes are "staggered;" but there is nothing of special note to record, all these various boilers, of course, differing in detail and minutiæ.

The Heine boiler differs more materially. It has headers which are simply flat stud-stayed chambers of boiler plate, and its large overhead drums are parallel with the inclined water tubes which are expanded into the header chambers. The inclination, however, is small, 1 in 12 only. The mud drum of the Heine boiler is in the overhead drums, which are two in number. These mud drums are simple cylinders closed, except for about 18 inches at the upper end. The feed is let into the mud drum, falls to the lower end, and becomes gradually heated, and finally escapes by the open end, having, it is claimed, probably with truth, left its scale forming ingredients in the drum, where not being in danger of baking, they can be blown out as they accumulate. This is the sort of mud depositor that could be so easily applied to the Lancashire boiler with advantage. The two upper drums are again surmounted by a transverse steam drum, which strikes us as small in capacity.

On a general review, whatever may be the advantages in ease of repair, small diameter of parts exposed to pressure and ease of transportation, the water tube boilers at Chicago do not specially commend themselves to our ideas of what a steam boiler should be.

They appear to be gaining ground in America, where the attention given to boilers is not always of the best.

The frequency of explosions in America is much greater than it is here, and the plain boiler of large diameter has had to bear the blame of insufficient construction.

With oil fuel as used, we understand, in all the boilers at Chicago, one main objection to water tube boilers disappears to a great extent; we mean the difficulty of maintaining a steady pressure under fluctuating load. With well regulated oil burning this can be done more easily than with solid fuels.

## ELECTRICAL ENGINEERING AT THE WORLD'S FAIR.

[From our special commissioner.]

### XIV.

The rotary effects of a two-phase alternating current field magnet are very well shown by the Westinghouse Company, and may be repeated by taking a ring armature wound with four coils, as in fig. 1.

Coil *a*, *b*, is connected to one of the two-phase currents; and coil c, d, to the other.

The ring armature is laid horizontally on a table, and a board placed over it, so that various articles may be laid on the board over the armature.

Almost any metallic or conducting article laid on the board will tend to spin round; copper balls laid on the board immediately start off running round above the ring. A penny-piece will spin on its edge, and run round above the ring; a screw, nail, or short bar of iron dropped on the board is immediately caused to revolve or run round; in fact, all round the ring, above and below, there is a rotary magnetic field; any movable conducting masses brought into the field tend to revolve. This simple and inexpensive apparatus would be very valuable to teachers in demonstrating the effects of two-phase currents when arranged to rotate.

Elihu Thomson's single-phase rotary apparatus has already been exhibited in Europe, and fully described; it is all shown here, and makes a very instructive exhibit.

Leaving the electricity buildings, we find the electrical machinery for generating the electricity used in the exhibition situated along one side of the Machinery Hall; the machines are of all kinds and makes, most of them well-known by advertisement, some of them wonderfully and fearfully made.

The Edison-Hopkinson dynamo is largely used, and large multipolar dynamos by the General Electric Company; there is nothing of much interest in these. Next to these are some large multipolar dynamos of extraordinarily bad design and poor construction; the sparking at the commutators bad, and the heating up of the whole machine something remarkable. No name was to be found on these machines; they had a funereal appearance, being all black.

The Brush arc dynamo is used in large numbers for the arc lighting; also the Thomson-Houston and Western Electric Companies' arc dynamos.

High-pressure closed coil armatures are to be seen working arcs in series; these machines seem to run pretty well up to about 1,500 volts. They spark, and wear at the brushes most

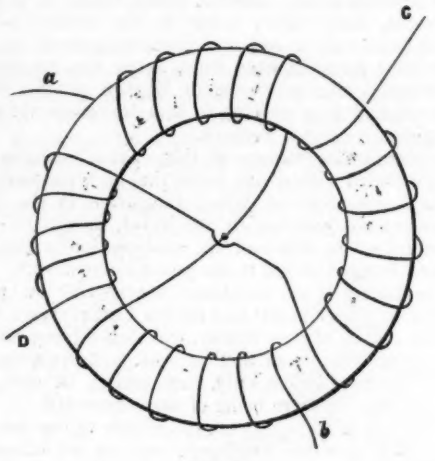



Fig. 1.

fearfully when the load alters; and most of them have complicated adjusting mechanism attached to the brushes for the purpose of regulating the E.M.F. to the load.

The arc dynamo, for running arcs in series, has had a large application in America, and, therefore, by experience they have learned a good deal about taking care of sparking at the high pressure commutators. But the devices adopted never abolish the sparking and consequent wear at the commutators; they only modify or moderate its effects.

The Westinghouse Company supply the current for incandescent lighting, and for that purpose employ a dozen large alternators of peculiar design. They have drum armatures of Paccinotti style, with coils between projecting teeth; the poles are inward, projecting from a circular frame. So far this is all common construction, but in each machine there are two field magnets and two armatures side by side. This seems quite incomprehensible; it looks like returning to the days when American dynamos were made with a lot of field magnets side by side; long thin magnets, instead of one short thick solid massive magnet. Not only is the building of two magnets more expensive than building one, but using two magnets in place of one is less efficient. For two-phase currents this construction may have some advantages, but even then, although two armatures are desirable—one for each current—two field magnets, are of no advantage whatever.

These alternators are compounded by the method first proposed by M. Zipernowski and Mr. Rankin Kennedy, and previously referred to in these articles; the same method is also used by the Thomson-Houston people in connection with their alternators. It consists in passing the main current through the primary of a transformer, and then passing the secondary current rectified through the compounding coils of the field magnet. For constant E.M.F. this plan works to perfection. The secondary current increases with the primary current, and *vice versâ*, and this method was employed in Zipernowski's first alternators eight or nine years ago. In Mr. Rankin Kennedy's method for constant current the primary of the transformer is placed in series with the load or lamps, and the secondary is used as a demagnetising current on the field magnet.

Two of these large alternators are driven by belts from a large fly-wheel; they are about 300 H.P. each. This combination allows of the use of a large slow speed engine and high speed alternators. Such arrangements are not very much favoured in Europe; the immense space required cannot always be afforded.

Other two of these large alternators are coupled direct to high-speed Westinghouse compound engines, and form a very compact and efficient combination.

The large combined engines and dynamos of Siemens and Halske are also here, as shown at Frankfort, and also a Willans central valve high speed engine coupled to a Siemens dynamo for 1,000 ampères.

## THE RESISTANCE OF THE HUMAN BODY TO INTERRUPTED CURRENTS.

In the *Weckblad* of July 22nd, 1893, there appears a valuable contribution on the electric resistance of the human body to interrupted currents, from the pen of Dr. J. L. Hoorweg. It first deals at length with the experiments of Gärtner, who is thought by some to have found that the resistance of the body depends upon the "tension of the poles," or the E.M.F. of the applied currents, also that the resistance is less for the opening induction shocks than for the closing. The author then goes on to state, "I have repeated Gärtner's experiments entirely in the same manner, with the same electrodes, and in every respect confirmed his results. The difference between the metal rheostat and the human body is remarkable and surprising. But is it really proved that the human body possesses a different resistance for the different induction shocks?" He then goes on to show that the logical outcome of such a contention is that, "in the law of Ohm, $i = \frac{e}{r}$ $r$ becomes a direct function of $e$," and this seems to him an insurmountable difficulty.

He then describes some experiments of his own, in which he sought some inorganic substances which present the same phenomena as those which Gärtner observed in the human body. Wet paper, the carbon rheostat of Englemann, and a faulty contact between a wire and a screw, were all found to produce the same results. From these experiments "it is, therefore, not necessary to attribute the resistance to a vital cause, which, besides, has been exemplified by Gärtner himself, who observed the same phenomena in corpses." "But is it reasonable to suppose the human body similar to variable contacts? In my opinion there is but one explanation possible: the phenomena are a consequence of accumulation of electricity, of what is called capacity." After dealing with capacity in general, Dr. Hoorweg says: "If, therefore, the human body possesses a great capacity for accumulating electricity it will act under induction shocks differently from ordinary metal wires. In reference to electric shocks this capacity produces in the human body about the same changes of properties as the replacing of a glass tube by a gutta-percha one on the rapid oscillations of water. Even as all rapid shocks in the motion of the water by the influence of elastic walls become less abrupt and change into oscillations, so will the electric currents change in the human body; and besides, this capacity will force the body to act differently under the rapidly passing and high tensioned shocks of the opening, than under the slower and weaker of the closing."

By ascribing to the human body a certain capacity, C, the formula for quantity, Q, under induction shocks, becomes $Q = M T \times V C$, where M equals the coefficient of mutual induction between the coils; T, the strength of the primary current, and V the velocity of the secondary current. V being greater at the opening than at the closing, the open-shocks give higher results than the closing.

After referring to Fleming's alternate current transformer curves, and pointing out that the maximum effect of the opening shock cannot be attained immediately, but that there must be a short period of increase, he goes on to say that in Gärtner's experiments "it was not the resistance of the body which was measured, but the quantity, V C. All is explained by admitting that the body possesses a certain capacity."

The body cannot, however, be compared with an ordinary condenser. It is more like a submarine cable which possesses great capacity, but at same time can transmit current through its length. This was demonstrated by the following experiment: In one of Kohlrausch's condensers two vertical collector plates were placed $\frac{1}{4}$ mm. from each other. On connecting up no deviation was observed. Then a drop of water was introduced between the plates, and at once distinct deviations, similar to those observed with the body, were obtained.

"The electricity passes through the fluid, but influences and condenses by the intervention of the non-conductive dielectric; and, in conclusion, do we not find in the non-conductive epidermis of the human body, with the conductive moist electrodes on the one hand, and the conductive

muscular tissues on the other, a similar conductive condenser?"

The author considers he has proved his view of the condenser action of the human body by bringing into circuit with his apparatus, first one person and then two, holding each other by the hand. "The result was that the galvanometer, with the same induction shock, marked for two persons about twice the number as for one." "Considering how enormously the resistance is increased when two persons hold each other by the hand, this test seems conclusive."

Mathematical proof then follows, based upon Lord Kelvin's calculations for submarine cables, and some interesting curves are shown.

Of course, this idea of comparing the human body to a leaky condenser is by no means new. We think it was first mentioned by Dr. W. H. Stone so long ago as the year 1886. Dr. Hoorweg may, or may not, be aware of this. He does not mention it, but, be that as it may, he seems to have given a new value to the comparison by the thoroughness with which he has investigated the matter, and the careful way in which he arrives at his proofs.

The paper then goes on to show that the apparent high resistance of the body to high frequency currents can only be attributed to self-induction. Maxwell is quoted as showing that by rapid vibrations the self-induction causes the current, "by degrees, to leave the axis of the wire to glide, at last, only over the surface." Then Lord Rayleigh's formula for R, under such conditions, viz., $R^1 = R\left[1 + \frac{p^2 l^2 u^2}{12 R^2} + \&c.\right]$ is considered in its application to the human body, and the following correction is arrived at $\frac{d^2 u^2}{12 C^2 R^2 w^2}$ where $w$ = the specific resistance, $d$ the diameter of the conductor, and $u$ the coefficient of magnetic induction.

An example is given wherein the value of $w$ (the specific resistance of the body) is taken as equal to that of the muscular tissue, viz., $2\frac{1}{2}$ million times that of mercury. This appears to be rather a weak point in an otherwise strong paper, for any value given to the specific resistance of the body is at least open to question, and a formula which includes a symbol of purely speculative value must necessarily be of little real use.

Dr. Hoorweg goes on to say that the human body is best compared with a wire of cylindrical form, and even if it were a million times larger, the effect upon its resistance would be small. "Because, therefore, of the great specific resistance of the human body, its resistance even to the most rapid condenser discharges is not perceptibly increased."

The paper concludes by expressing the opinion that what Maxwell predicted and Lord Rayleigh and Hertz found confirmed by tests with wires, viz., that, with high frequency discharges the electricity glides over the surface without penetrating to the interior of the conductor, may be also true with the body; and that D'Arsonval's recent tests with a lamp show only that a certain number of watts, say, 6 (12 v. and 0·5 amp.) were expended in bringing it to incandescence, "but leave the question undecided whether the number is obtained from $12 \times \frac{12}{24}$, or from $1{,}200 \times \frac{1{,}200}{240{,}000}$."

## STEAM ENGINES AT THE WORLD'S FAIR.

In Mr. Clark's third paper on the above in the current number of *Cassier's Magazine*, there are a few novelties which are of interest, but generally the engines described are more or less a repetition of those already noted.

A sectional view is given of the cylinders of a compound engine by McIntosh, Seymour & Co. Between the high and low pressure cylinders, which are tandem, there is a long metallic sleeve lined with Babbitt metal, compressed in place and bored to fit the piston rod. There is a self-adjusting arrangement for taking up wear, and the area of bearing is almost equal to that of the cross head, the brush thus serving to carry the weight of the pistons and rods. It is held by a gland only to the rear or H.P. cylinder, and can be pushed right into this cylinder when it is desired to remove the L.P. cylinder head.

There are piston valves to both cylinders of a type becoming common in America, which strike us as a little cumbersome, both valves being in one casting of large diameter from end to end, and the arrangement of cut-off sleeves riding upon the main valve being also unnecessarily complex and decidedly inferior to English piston valve cut-off devices, and very wanting in that directness which often distinguishes American methods.

The intermediate receiver of this engine contains copper heating coils fed with steam from the high pressure jacket, with the double object of drying the steam in the receiver and securing a circulation in the jacket, though this seems only secured to the extent of the condensation in the coil, an altogether insufficient aid to the jacket circulation.

In the Ball & Wood horizontal engine the low pressure valve is somewhat similar to a double Corliss valve rocking under the middle of the cylinder, and thus serving both ends of the cylinder for steam and exhaust, an arrangement suitable for short cylinders only, and giving, in such, fairly short passages, the valve being of large diameter.

In the New York safety engine, piston valves not unlike the English type are employed, and in all these small American engines regulation is effected by a fly-wheel governor varying the eccentric throw.

For the driving of the 2,000 H.P. dynamo of the Intramural Railway, the E. P. Allis Company have supplied a Reynolds-Corliss engine of compound type, with cylinders 32 inches and 62 inches diameter by 5 feet stroke, coupled at 75 revolutions direct upon the dynamo armature of 10 feet 6 inches diameter. The breadth of this armature is 3 feet, and its weight 70,000 lbs. The field is of cast-steel, and carries 12 poles. The voltage is 600, and an efficiency of 86 per cent. is *claimed*. The shaft weighs 110,000 lbs., and the fly-wheel 164,000 lbs., the total revolving weight being thus 160 short tons.

We do not gather that there is a third bearing for the shaft; indeed, the illustration appears to negative this supposition, but the length of this shaft between bearings is very great, and we conclude that the diameter, 24 inches, has reference only to the necks, and that the wheel seat is, we hope, very considerably larger.

Engines by the Bass Foundry Company, of Fort Mayne, and by Russell and Co., of Massillon, are merely interesting as being variations from others already described. If an enormous variety be evidence of the endeavour of Americans to improve their stationary engine work, we have such evidence in plenty, the numberless different makes contrasting strongly with the dead uniformity in American locomotive work, which has been until lately so very inferior, and now that Americans are striving after better running and higher speeds, we find similarly that their locomotives are beginning to vary in design after the manner to which we are accustomed in England, where we have looked upon variation as a sign of progress. The remarkable feature of the stationary engine exhibits at Chicago is the large number of engines which are shown by many of the exhibitors, as though it had been thought necessary to make a big display, where a single engine would have been enough to demonstrate what the exhibitors could do.

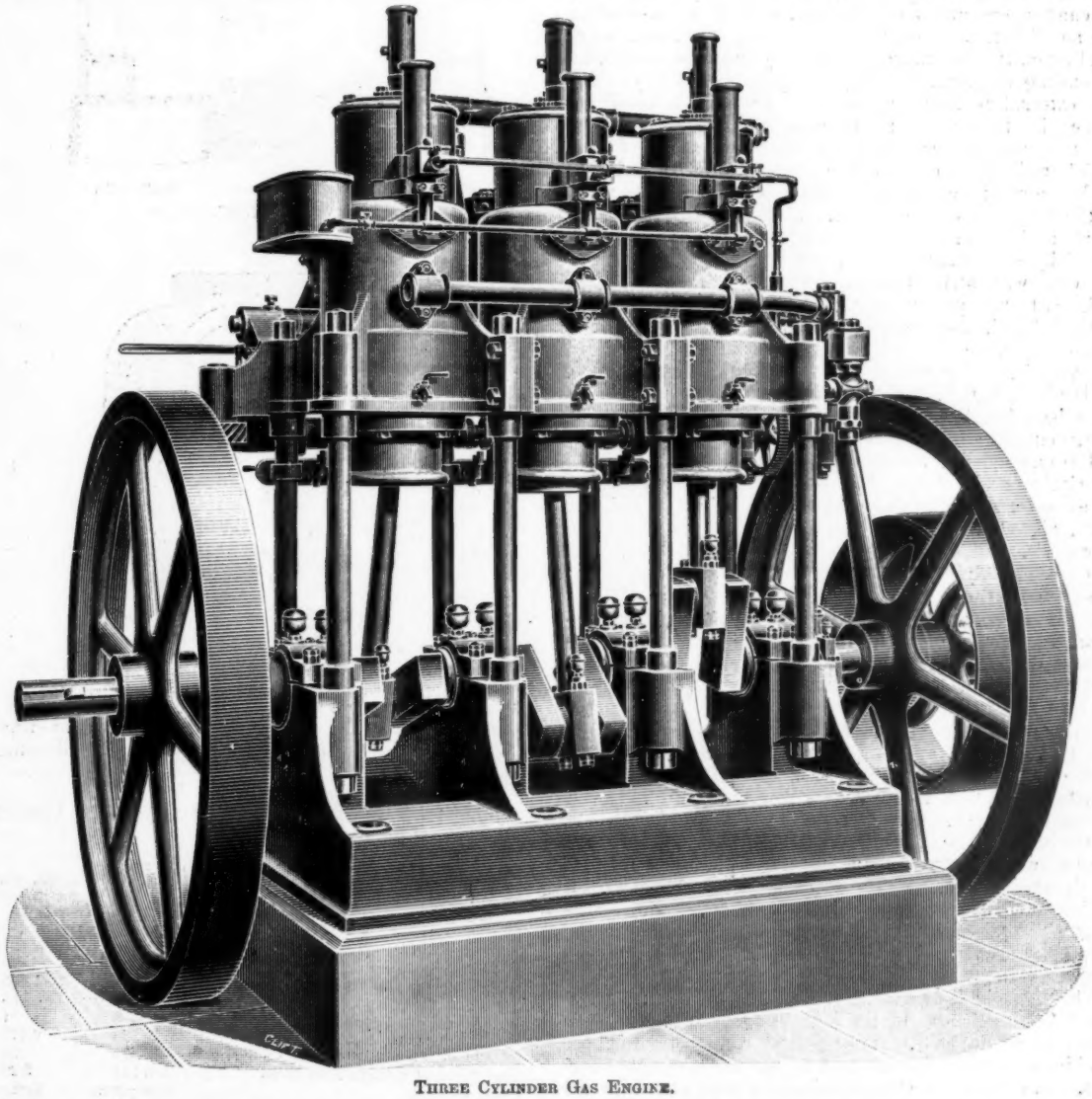
## A THREE-CYLINDER GAS ENGINE.

What seems to be quite a new feature in gas and oil engines is the three-cylinder type now being made by Messrs. Weyman & Hitchcock, of Guildford. Inverted cylinders are used in accordance with the best steam engine practice, by which means, it is assumed, a large amount of vibration is done away with. The cranks are set at an angle of 120°, so that with three cylinders all the pistons, cranks and connecting rods balance each other. The whole design is essentially according to that of the marine engine, the bed being a substantial casting with brackets cast on, which take the bearings and columns, the latter being eight in number,

turned out of solid steel bars, these columns carrying the cylinders overhead; the exhaust and air valves are of the usual mushroom type, and are worked by cams on a lay shaft through levers pivoted on a second shaft. The cam shaft is worked by a double set of skew gearing from the crank shaft.

Each cylinder forms a complete engine in itself, and can be worked separately or in conjunction with either the second or third cylinder, and by this means full load economy can be obtained with a one-third, two-thirds, or full power of the engine. By having the three cylinders and the cranks at 120°, five impulses are obtained every three revolutions of the crank shaft. Thus, while the economy and reliability of the four cycle is retained, the impulses due to the principle are, as it were, eliminated and a very even turning movement obtained, which makes the engine, we are informed, particularly suitable for electric lighting as well as for purposes where a varying load is required.

The governor is of the centrifugal type, and acts on the three cylinders, admitting oil or gas, as the case may be, or cutting it off; by a very small adjustment of a set screw, one cylinder may be made to cut off earlier than the rest. By using this form of engine, it is pointed out that the smallest space is taken up in comparison to the power. The over-all width of the engine is only the diameter of the fly-wheel. The makers of these engines have supplied several of the design described, both for Government works abroad, and for electric lighting purposes at home, and they are manufactured from 10 indicated horse-power upwards.



Three Cylinder Gas Engine.

## ARC LIGHTING.

By E. TREMLETT CARTER.

(*Continued from page* 202).

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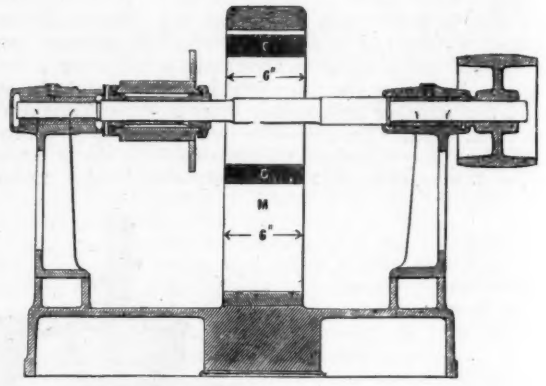
X.

The field magnet coils of continuous current dynamos for series arc lighting are invariably placed in the main circuit, in series with the armature and lamps, and are designed to carry the whole current. They will be of low resistance, will cause only a small drop of voltage, and will consist of few turns of thick wire, which will absorb only a small amount of power. There are two chief reasons for this arrangement of the field coils. In the first place, as we have seen, the terminal voltage of the dynamo has generally to be very high, the value being proportional to the number of lamps which are to be run by the machine. This would cause a great length and a high resistance of shunt-winding, if the alternative shunt method were adopted instead of the series; and the expense of putting on so many turns of thin wire would seriously affect the price of the machine. Generally speaking, it is for this reason not customary to adopt shunt coils in dynamos having a higher terminal voltage than about 400 volts. In the second place, a form of series winding has greater stability in respect of maintaining the regular output of the dynamo under the ordinary conditions met with in working a series arc circuit. In such a circuit the starting resistance is, as we shall see more fully

in a later section, much lower than the regular working resistance. The reason for this is that the pairs of lamp carbons are all in actual contact when the lamps are not running, so that the external resistance consists merely in the cables, coils and carbons. If shunt-winding is adopted, this very low initial value of the external resistance will be far below the critical resistance of the dynamo at the speed at which it is designed to run. In other words, the external resistance will be too small for any current to circulate in the field coils; and, the magnets remaining with only their residual magnetism to give any E.M.F., will be unable to produce a working current in the external circuit. The difficulty could only be got over in an unpractical manner, namely, by having a high auxiliary resistance in the circuit at the instant of starting the dynamo, then switching this resistance gradually down to zero. Such practice would be cumbersome and unsatisfactory, even if shunt-winding was not objectionable on the other score. But, with series winding on the field magnets of the dynamo, the conditions are entirely different, and they are quite satisfactory. The low external resistance at starting produces a condition which is favourable to running up the machine to its full working current; for the low value of the initial resistance enables the small initial E.M.F. to produce a greater current than would be the case if the value of the resistance were constant. Moreover, series winding adapts itself to the fluctuations of resistance during working, caused by adjustments in the lamps; and this is especially the case with series winding when the ampère-turns are designed to nearly saturate the field core. It may be remarked that the usual objection opposed to the series form of field winding, where there is a back E.M.F. in the circuit, as, for example, in charging storage cells, does not apply here, for the back E.M.F. of the electric arc—if such exists—has never been found to be capable of producing a reversed discharge current; it possesses no "inertia."

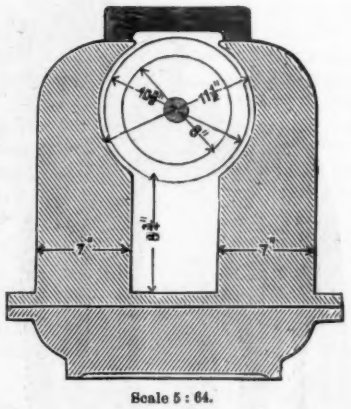
The remainder of the present section will be devoted to a descriptive study of the chief types of continuous current dynamos for series lighting, and we shall deal, in the first place, with closed coil dynamos, taking open coil machines afterwards. The reader will, it is hoped, understand that it would be entirely beyond the scope of such a treatise as the present to deal with all the problems in the design of these dynamos, or even to give a complete description of the types which are brought under his notice. An engineer who proceeds to design such a dynamo as any we shall consider, will require to know the principles and the practice upon which are founded the design of such details as the size and number of turns of wire on the armature, or on the field magnets for any given E.M.F. and output, the cooling surface which these coils must be provided with, the proportions of the armature core, field magnets and the commutator, and the mechanical considerations of the size of the armature shaft, of the bearings, &c. But these are questions for the solutions of which the reader must take up some standard work on dynamo design, and on the strength of materials for engineering details. Here we can only consider those questions which *specially* affect the design of a dynamo for the purpose of arc lighting; and the best way of doing so will be to study what has been done by various makers.

The "Phœnix" dynamo, manufactured by Messrs. Paterson & Cooper, is one of the best known dynamos having closed armature coils. The general construction of the machine is the same for constant voltage as for constant current, and comprises a Gramme-ring armature placed in the field of a two or four-pole magnet. Both the ordinary and the inverted forms of magnet are used in the smaller machines, and the larger dynamos are sometimes arranged with horizontal magnets, producing a vertical field between the poles. The same construction and quality of field magnet or "carcase," and of armature core, is used, whether the machine is to be wound for constant current or constant volts; the chief difference between the finished machines lying in the character and weight of coil winding. To take an actual example, fig. 27 shows a longitudinal section of the entire carcase of a "Phœnix" dynamo for an output of 6 kilowatts; and fig. 28 gives the end sectional elevation of the same carcase. The principal dimensions are given in the diagrams, and it will be seen from these that there is a section of 42 square inches of iron in the field magnets, and of nearly 16 square inches on the two sides of the armature, for the "flow" of magnetic induction. The total weight of iron in the armature core is about 57 lbs., and in the field magnets about 560 lbs. The air gap is $\frac{7}{16}$ths of an inch. This carcase is wound with shunt and series magnet coils for




C, Core discs; M, Magnet. Scale : 6 .

Fig. 27.




Scale 5 : 64.

Fig. 28.

constant voltage, and with series coils for constant current; and the following table gives the details of the winding in the two cases.

Table of Winding of a 6-k.w. (No. 7 S) Phœnix Dynamo.

| Quantities. | Constant volts. | Constant current. |
|---|---|---|
| Voltage ... ... ... ... ... | 100 | Up to 600 |
| Current ... ... ... ... ... | Up to 60 | 10 |
| Revolutions per minute ... ... ... | 1,360 | 1,200 |
| Diameter of wire on armature, in inches | 0·077 | 0·048 |
| Number of wires in parallel on armature | 2 | 1 |
| Number of turns on armature ... ... | 336 | 2,112 |
| Weight of wire on armature, in pounds | 19 | 24 |
| Resistance of armature, in ohms ... | 0·113 | 3·29 |
| Field winding ... ... ... ... | Compound | Series |
| Diameter of shunt coil, in inches ... | 0·042 | None. |
| Diameter of series coil, in inches ... | 0·238 | 0·109 |
| Shunt turns ... ... ... ... | 3,204 | None. |
| Series turns ... ... ... ... | 104 | 1,740 |
| Shunt resistance, in ohms ... ... | 57·5 | — |
| Series resistance ... ... ... ... | 0·052 | 5·17 |
| Weight of wire in shunt, in pounds ... | 53 | 0 |
| Weight of wire in series, in pounds ... | 50 | 189 |
| Total ampère turns on field at full load | 11,900 | 17,400 |

The instructive information upon which the author has based the foregoing table was kindly given to him by Messrs. Paterson & Cooper, to whom he is also indebted for the scale drawings and diagrams illustrating the "Phœnix" dynamo. An examination of the table reveals the following vital points. (*a*) The iron is more highly magnetised in the arc lighting machine than in the compound-wound

machine; (*b*) The weight of copper is greater, in proportion to the weight of iron, in the former than in the latter; (*c*) The turns on the armature, and therefore the number of turns on each section, is greater in the former than in the latter case. The reduced speed of the arc light machine is an incidental and not a vital point; it is caused by the fact that there is a greater flux of magnetic induction through the armature core in this dynamo. We shall now briefly discuss the purpose of these points of design.

There being a large number of turns on each section of the armature (because of the high E.M.F. required), and the armature being composed of closed coils, there will be a very high E.M.F. of self-induction at each section as it comes under the brush, and is short circuited in its passage from one side of the axis of commutation to the other. Further,

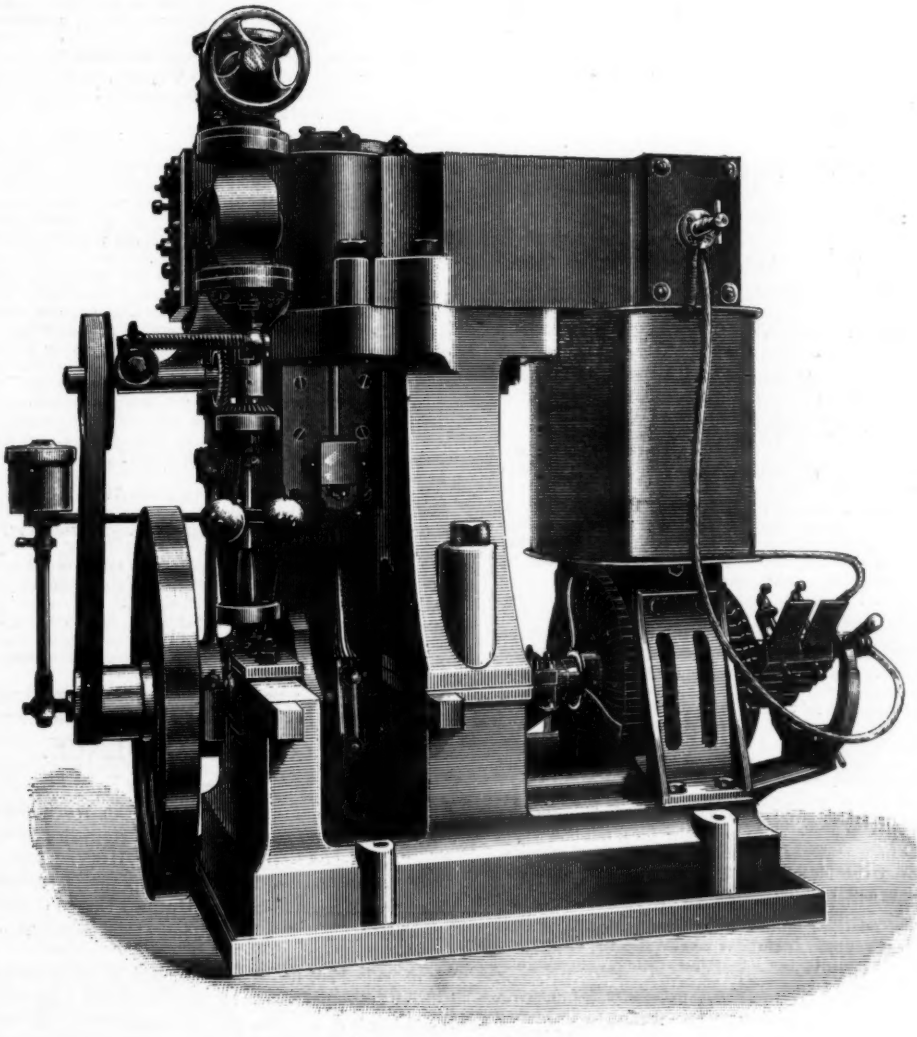


Fig. 29.

the number of such turns in any one section being constant, and the armature current being constant also, this E.M.F. of self-induction will have the same value whatever may be the position of the brushes. Now, if the load on the machine is to vary, it will be necessary to give the brushes a correspondingly varying amount of lead, so that the sections will be short-circuited in various parts of the gap field, according to the position of the brushes. The intensity of this gap field determines the perfection with which the injurious effect of sparking is prevented, for it is the E.M.F. due to this gap field which, in a closed coil machine, is made to reverse the current in the section against the E.M.F. of self-induction. Now, if, as we have said, the E.M.F. of self-induction is constant in value, it will be necessary that the strength of the gap field shall be constant also, over all that range of movement which the brushes will be required to have for perfect regulation between the designed limits of the working load. Moreover, since the E.M.F. of self-induction is very high, it will be necessary that the strength of the gap field in all these places shall be very high also, in order completely to prevent sparking. The problem, then, is to obtain a strong and uniform gap field over the stated range of movement of the brushes. In dealing with this problem, Mr. Esson has found (*Proceedings* of Inst. Electrical Engineers, Vol. xix., No. 85) that it is quite impracticable to fulfil these conditions if the brush is arranged to be sometimes under the horn of the pole piece and sometimes well away from that horn; or, in other words, if the reversing section is sometimes reversed under the pole arc and sometimes in the gap between the two pole arcs. On the other hand, since the lead will require, at its maximum value, that the brushes shall be well in advance of the neutral line of the field, it will be impossible to design a good form of field magnet which would enable the entire range of position of the brushes to take place beyond the polar arc. The only practicable solution which remains is, therefore, to have sufficiently large embracing poles, to arrange that in every position of the brushes the commutation will take place directly within the polar arc. Having settled upon this practice, we must, of course, now proceed to arrange that the gap field within this polar arc shall be everywhere of constant intensity. This can only be done in a practical way by bringing the iron very nearly up to its saturation point, so as to crowd the lines of induction more uniformly through the iron. The practice is not, of course, a strictly economical one, as it involves a very considerable reduction in the permeability of all parts of the

iron circuit of the magnetic induction, and, consequently, a greater number of ampère-turns on the field coils; but it has the merit of getting over, in a manner which can be cheaply carried out in the workshops, a difficulty which if solved by the more theoretically economical method of specially shaping the pole pieces, would become a great expense in the manufacture of the dynamo. Besides this, the practice of bringing the iron more nearly up to its saturation point gives, with series winding, that drooping form of external characteristic which we have seen is of use in assisting the other modes of regulation which may be employed. Messrs. Paterson and Cooper have found that a very satisfactory mode of regulating these machines, when they are run on a fairly constant number of arc lamps arranged in series, is to couple each machine to a separate steam engine, and to let the load on the dynamo govern the speed of the engine. The plant for this kind of working is shown in fig. 29. The centrifugal governor, seen on the left of the figure, is adjusted so that it does not actuate the throttle-valve unless the engine "runs away" on account of its losing load. No other form of governor is fitted to the plant. The brushes of the dynamo are capable of a wide range of position without sparking, and are attached to a rocker which can be moved by hand.

*(To be continued.)*

## ZIPERNOWSKI, DÉRI AND BLATHY v. THE COMPAGNIE INTERNATIONALE D'ELECTRICITÉ, OF TOURS.*

THE Cour d'Orléans has recently given judgment for the plaintiffs in the infringement case between Messrs. Zipernowski, Déri and Blathy and the Compagnie Internationale d'Electricité, of Tours.

On August 10th, 1887, the Civil Tribunal of Tours decided that the Gaulard and Gibbs transformers were not an infringement of the Zipernowski patent. The Cour d'Orléans has reversed this decision on the following grounds:—

The patent taken out in France, March 20th, 1885, by Messrs. Zipernowski and Déri, entitled, "Montage des transformateurs électriques," claimed the automatic and instantaneous regulation of the local circuit, so that if one or more lamps in the circuit should be extinguished, those remaining alight would not be affected.

To obtain this result the inventors proposed to place the transformers in derivation on the principal circuit, to maintain a constant tension at the primary terminals of the transformer, and to arrange the transformer so that the tension of the primary current is transformed into a sufficient quantity in the secondary circuit. By this arrangement the extinction of one or more lamps in the secondary circuit immediately develops in the primary a counter electromotive force on the entrance of the current.

It is shown by the evidence that it is this invention that has been applied both at their works and in their installations by the Tours Electric Lighting Company.

The judges in the first action decided that the arrangement of electric transformers in derivation was not invented by Zipernowski and Déri; that their patent did not embody a new idea, but one which had become public property; that in 1874 the English electrician, Fuller, had conceived the idea of distributing electricity by transformers in derivation, and that he took out a patent to this effect, December 21st, 1878.

Moreover, the defendants maintained that the plaintiffs' system has not brought about any new industrial result. On the other hand it appears from the report of the experts, Fribourg, Jousselin and De Parville, that no claims of priority of invention can be established against Zipernowski and Déri. After having carefully investigated each of the claims of priority brought forward by the defendants, they say: The investigation of these claims shows us that at the date of the Zipernowski and Déri patent, no inventor had realised, with an industrial object, the combination of the three methods claimed in their patent.

An invention is considered new when, for the first time, known elements are combined to procure a result not hitherto obtained. Therefore the plaintiffs are entitled to the claims of their patent of March 20th, 1885.

The second patent, taken out by Messrs. Zipernowski, Déri and Blathy, April 21st, 1885, and entitled "Transformer with closed magnetic core without poles," was declared null and void by the tribunal. This decision was based on the Hopkinson patent taken out October 28th, 1884, and on the "disclaimer" given in England by the plaintiffs, October 29th, 1886.

The experts affirmed unanimously that the combination of the closed magnetic core without poles constituted a new invention at the date of the patent taken out by the plaintiffs; that they could discover no prior claim to this idea, either in the employment by Gramme of a closed magnetic core in his dynamo-electric machines, or in the English patents taken out by Fuller, December 21st, 1878, Hopkinson, August 3rd, 1887, and Varley, December 24th, 1856; that the claim of priority in the Hopkinson patent of October 28th, 1884, referred to by the Court, could not be allowed, as this patent had not, at time the Zipernowski patent was taken out, received sufficient publicity; for as Hopkinson had taken out in England on October 28th, 1884, a provisional specification, it had been kept secret, in accordance with the English law, and it was not until July 27th, 1885, after Messrs. Zipernowski, Déri and Blathy had taken out their patent, that Hopkinson's final specification was drawn up, and his invention made public.

The defendants maintain that according to Article 29 of the law passed July 5th, 1884, against the importation of patents, Hopkinson alone could patent in France the invention for which he had obtained in 1884 a patent in England, and that to allow Messrs. Zipernowski, Déri and Blathy's patent would be a violation of this article. This law, however, although it reserves to the inventor the right of patenting his invention in France, as well as abroad, does not prevent any other inventor from taking out a patent in France while in ignorance of the discovery made and patented abroad; this case cannot be considered an importation of a patent, as the person patents an invention of his own, while the discovery made abroad is still a secret.

Again, the disclaimer given in England by the plaintiffs, October 29th, 1886, cannot be brought forward as evidence against them, as the English law dates a patent from the time of its provisional specification; thus the Hopkinson patent would be considered prior to that of Zipernowski, Déri and Blathy in England, but not in France, and they therefore had to give a disclaimer, as, according to English law, any patent containing a claim capable of being annulled, is considered null and void altogether.

The defendants also brought forward a passage in Du Moncel's treatise on electric lighting, showing that in 1883 this writer described a transformer with closed magnetic field; but on being submitted to experts, it was shown that the supposed priority did not exist, Du Moncel having merely described the provisional specification of Fuller, which had already been investigated by the experts, and that if Fuller's magnetic core is closed, it is not without poles, like that of Messrs. Zipernowski, Déri and Blathy.

The defendants also maintain that the apparatus constructed by them did not constitute a magnetic field with closed circuit without poles, and that with regard to this point, the experts contented themselves with mere suppositions. It is shown, however, by the report drawn up by the experts from observations made at the works at Tours, that they consider that "the Gaulard and Gibbs apparatus are constructed with closed magnetic core without poles," at the same time stating that they consist of two straight columns connected by crowns, the bobbins being wound only round the straight parts; but their arrangement constitutes really that of the closed magnetic core without poles, which is the property of Messrs. Zipernowski, Déri and Blathy.

Moreover, the report drawn up April 17th, 1886, by the sheriff's officer, assisted, at the desire of the President of the Civil Tribunal of Tours, by Delage, engineer of arts and manufactures, leaves no doubt on this point.

The plaintiffs are therefore justified in their claims in both patents.

The Court declared therefore that the Tours Company had infringed the patents taken out March 20th, 1885, and April 21st, 1885, by Messrs. Zipernowski, Déri and Blathy, and ordered them to pay damages to be fixed by the Court, and to give up the 18 posts of transformers with closed core without poles established at Tours.

* *L'Electricien.*

## CORRESPONDENCE.

### Electrical Engineering at the World's Fair.

In the article entitled, "Storage Batteries at the World's Fair," published in the ELECTRICAL REVIEW for August 18th, 1893, which has just come to my notice, your correspondent describes in some detail the Union Electric Company's cell.

I desire, with your permission, to correct one or two slight errors.

On page 175, fig. 3 is described as illustrating the "K" cell with a capacity of 15 ampère-hours. In reality, it illustrates the "F 5" cell, having a capacity of 250 ampère-hours.

Again, your correspondent criticises a "dynamo" exhibited by the Union Electric Company, stating that it would be better to dispense with the revolving brushes, and use the machine as an alternator. Your correspondent is undoubtedly right to a certain extent, for, as an alternator, the machine would be simple and effective; but the machine, as exhibited, is a direct current constant potential *motor*, in which the inventor has endeavoured to obtain a given power with the lowest speed, lightest weight, and smallest volume attainable, with the object of securing a motor especially adapted to direct-coupled launch and car service, where these requirements are factors of moment.

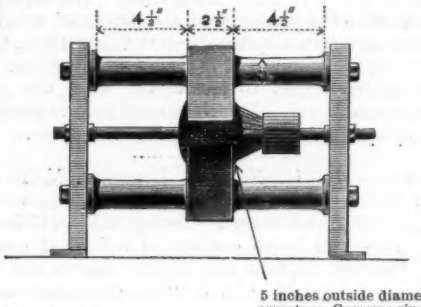
The motor exhibited has a framework of aluminium, and weighs only 312 lbs. On a 110-volt circuit it develops 3 H.P. with 25 amperes, running at 800 revolutions per minute.

**Thatcher T. P. Luquer,**
*Engineer Union Electric Company.*

New York, *September 21st*, 1893.

### Construction of Small Dynamo.

As a reader of your instructive and interesting paper, I venture to ask the following question: I am engaged in constructing a small dynamo, a sketch of which I append, with principal dimensions given. It is required to give 8 to 10 ampères at 45 to 50 volts, and to light 6 20-C.P. lamps. The field magnets are of cast-iron, the armature being of wrought-iron, laminated, with a commutator of 10 divisions.




5 inches outside diameter of armature, Gramme ring type.

Could you kindly tell me through your columns the amount, W.G. and insulating material of wire (whether cotton or silk?) required for winding armature and fields? Thanking you in anticipation.

**Thos. Walley.**

[The best results, if any at all, to be got from this machine, should be with No. 16 W.G. wire on the fields and No. 20 wire on the armature, cotton covered, and varnished with shellac after winding. But from the dimensions given, we are afraid that our correspondent will not get any output from this machine, except at very high speeds, say, about 3,000 per minute. The magnetic resistance of the cast-iron and air spaces in this machine are so great, owing to the thinness of the field magnet cores and the short length of the armature, that it would require too much exciting power to magnetise it. It may, if wound as above, be used as a motor, although it fails as a dynamo.—EDS. ELEC. REV.]

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### Arc Lighting.

Will you permit me to avail myself of your columns to express my thanks to Prof. Carhart for his offer to pilot me round the exhibits of closed coil high pressure dynamos at the Chicago Exhibition, which, however, owing to the pressure of other affairs, I regret to have to decline. Nor indeed is it necessary for me or anyone to journey so far as to Chicago in order to see the kind of dynamo Prof. Carhart champions for series arc lighting—the high pressure, closed coil, constant current dynamo. It is not quite unknown in this country, and in Switzerland one meets with it in more than one power station. In my series of articles on "Arc Lighting," I have not denied its existence; on the contrary, my criticisms of it must imply a knowledge of it. Prof. Carhart seems to think that I have stated that this dynamo is a physical impossibility, whereas I have done nothing more than attempt to show that it involves points of design which make it, both structurally and from a commercial point of view, inferior to the open coil type. In thus originally stating the case, and in adhering to it as I do now, I believe I carry with me the judgment, in my favour, of the dynamo experts and authorities in this country and in Europe. I do more; I carry with me the weight of opinion of the chief experts and authorities in America, from which country Prof. Carhart writes, and to the arc lighting practice in which country he invites my special attention. For where, better than in America, shall we find the extensive and successful use of open coil armatures; or where, if not in the United States, has the superiority of the Brush and Thomson-Houston types of dynamos for arc lighting been established? In inviting special attention to American practice, Prof. Carhart points us to the one triumphant proof of our contention and to the fallacy of his own. But I must add that it was chiefly American practice of which I was thinking when I penned the disputed criticisms. I am equally sure that it was as much to the practice in that country as in this, that Dr. S. P. Thompson referred when he observed, in his excellent treatise on dynamo-electric machinery, that experience is mainly against the use of armatures of the closed coil type. Dr. Thompson's opinion is specially valuable as being that of an expert who is not personally interested in either mode of winding high pressure armatures; but I may conclude by mentioning that a leading firm of manufacturers of closed coil constant current dynamos, on this side of the Atlantic, have told me that they would much prefer to run series arcs on the Brush or Thomson-Houston machines than on their own, and, in fact, that they are actually doing so. It would not be fair for me to publish the name of this firm; but I shall be pleased to satisfy the editor privately as to the *bonâ fide* of my statement.

**E. Tremlett Carter.**

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Permit me to draw attention to an ambiguity in Mr. E. Tremlett Carter's expression for the economic law. On page 650, Vol. xxxii., he gives the following equation:—

$$s = 0{\cdot}873\, c \sqrt{\frac{w \,.\, z \,.\, f}{p \,.\, k}}$$

where $s$ = area of conductor in square inches.

$c$ = maximum current.

$z$ = cost of one E.H.P. at dynamo terminals for a full year in £.

$f$ = load factor of the mains.

$k$ = cost of additional plant per square inch of cross section of copper in the mains.

$w$ = energy in B.T.U. wasted per hour per square inch of section of copper with a current density of one ampère per square inch, the same length being taken as in $k$.

This is a novel and simple statement of the economic law involving the load factor of the mains, but in the example given by Mr. Carter on page 650, Vol. 32, there is some confusion in the values of $w$ and $k$ owing to the length of the cable selected, viz., 1,000 feet. I would suggest that Mr. Carter should illustrate the use of the equation by taking a practical unit length of copper, such as a yard, say. This would enable the student to grasp the meaning of the constants. It would be interesting, also, if the author showed how he arrived at the figure 0·857, for the accuracy of the equation depends on this being properly determined.

The economic law is of much importance, and Mr. Carter's equation expresses it in the most practical form I have seen.

**Albion T. Snell.**

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### The Cost of Wiring Small Houses.

It would be interesting and instructive to many of your readers if you or one of your correspondents who is familiar with such details, would kindly state in your columns the costs of fitting a new eight-room house with each of the following arrangements:—

Ordinary house bells throughout.
Electric bells with indicator in kitchen.
Speaking tubes from all rooms to kitchen.
Domestic telephones from all rooms to kitchen.

My excuse for troubling you in the matter arises from the fact that the information in its entirety is not readily obtained, and is often in request by builders and others. Among your many readers reliable facts will be forthcoming.

**E. O. W.**

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### Automatic Cut-outs.

Will you please tell me, through your columns, if there is an opening for an automatic magnetic cut-out, *without the use of mercury*, which, in charging accumulators on any overplus of current, cuts them out, and does not put them in circuit until a pre-determined current is passing.

**Automatic.**

Ystalyfera, Swansea Valley,
*September 28th*, 1893.

[Some of our readers will doubtless give our correspondent the information he desires.—EDS. ELEC. REV.]

## NOTES.

**Church Electric Lighting.**—A member of the congregation of the Leamington Parish Church has generously offered to lend, free of interest, the £250 required for lighting the church by electricity, the loan to be repaid by instalments of £50 per annum. The offer has been accepted.

**Lambeth Electric Lighting.**—Mr. Preece's report upon the electric lighting of the Workhouse and Infirmary was again considered by the Guardians last week. It was resolved that no further steps regarding the scheme be taken. The likelihood of the buildings being electrically lighted is therefore shelved for the present.

**Towing Canal Boats by Electricity.**—According to the New York *Engineering and Mining Journal*, it is now announced, that after correspondence with several companies, an arrangement has been made with the Westinghouse Electrical Company to put up an experimental plant to test the practicability of using electricity for towing on the New York State canals, the point chosen being the Rochester level. Transmission or trolley wires will be strung over the canal from poles set up on either bank. It is, of course, too late to have the plant in operation this season, but it is expected to be ready for the opening of navigation next spring.

**The Electric Light at the Chief Railway Station in Frankfort.**—The oil lamps have certainly disappeared, but the light is not everywhere as good as it might be expected from the grandeur of the installation. In the waiting-rooms the light is so dubious that at the dining tables the bills of fare can scarcely be read. The arc lamps in the platform hall leave much to be desired, and the costly Siemens machines stand idle in the cellar. The most recent addition to the installation, the great candelabrum before the main entrance, consumes 60 H.P., and only gives the effect of six lamps which do not even burn steadily.

**Government Telegraphs and Telephones.** — Mr. Henniker Heaton sends to the *Times* what he designates the second suppressed Post Office Supplementary Report. We make the following extracts from it on the telegraph and telephone question :—"Telegraphs.—As your Lordships will observe (p. 24), there is a deficiency on the telegraph service of £454,254. I have, nevertheless, added to the staff and their emoluments, so that, when the desired increase of telegraph business comes, there will be a staff sufficient to cope with it. I am told that business men marvel that 'sixpenny telegrams do not pay,' and impute the failure to gross mismanagement. We have, however, to pay £300,000 a year out of revenue as interest on the original purchase-money of the wires and plant. This ought to be taken off the telegraph estimates, according to the hon. member for Canterbury, and provided for by a sinking fund. He also suggests that the telegraphs should be made to pay, like the post, by reducing the rates so as to suit the pockets of the masses; beginning, say, with threepenny telegrams, and telegrams at a penny per word to France. There is also the competition of the telephones to be considered. Telephones.—By way of meeting the competition of the telephones, the Department purchased the trunk lines connecting towns at a cost of £1,000,000. It was then discovered that the profit did not arise on the trunk lines at all, but in the exchange business in the towns. We therefore proposed to acquire a share of the profits made by the National Telephone Company in the towns. To avoid awkward questions, we resolved to carry the matter through secretly, and I shortly refused to let Parliament see it before it was signed. Unfortunately, an obstinate Scottish corporation objected to give the company the right to take up its streets, and fix what rates it chose; several hon. members took the matter up, and finally I had to give way. The hon. member quoted so often insists that we should acquire the property and rights of the company, and develop the telephone service, at low rates, all over the country. That is a matter for your Lordships to decide. I have not thought fit to give in my report any statistics of the receipts from telephones; but I may tell your Lordships in confidence that we derived £54,000 from this source."

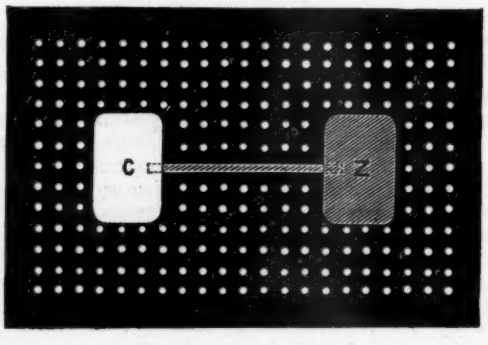
**Chichester and Electric Lighting.**—A committee was recently formed to consider the question of electric lighting, but no decision has been arrived at.

**Electric Lighting in Japan.**—The *Indian Engineer* says that the Japanese Government has decided to light its fortifications on the coast of Japan by electricity.

**Automatic Joint.**—The *Elect.-Techniker* describes an invention, by means of which the ends of two conducting wires can be united in a very short time. The arrangement chiefly consists of a double clip, the levers of which cross one another in such a way that, by extending them, the conductors are firmly clamped in the jaws of the clips. These jaws are suitably shaped to receive the wires, the gripping parts being roughened. The clamps are held in their closed position by springs, which press against the levers.

**Honours.**—Mr. H. Newman Lawrence, M.I.E.E., was elected a fellow of the American Electro-therapeutic Association, at their third annual meeting, held in Chicago last month. This Association consists of a limited number of some of the best medical men in the States, and has set itself the commendable task of "the cultivation and promotion of knowledge in whatever relates to the applications of electricity in medicine and surgery." To assist in the work it was decided to admit a few electrical experts as Fellows, and five were so elected, the other four being A. E. Kennelly, Prof. E. J. Houston, J. J. Carty, and M. J. Jenks. Mr. Newman Lawrence's efforts to improve the physics of medical electricity, and the steady perseverance with which he has pursued that object are well known on this side of the Atlantic, and we congratulate him upon receiving so honourable an evidence of appreciation from our American cousins.

**Patent Electric Plasters.**—"Strengthens the nerves! Imparts new life force to the weak and debilitated! When applied to the body, real and effective, though almost imperceptible, electric force is generated. In addition to having undoubted electric energy, they are made from a vegetable extract possessing healing, soothing, and strengthening properties, and are the best porous plasters in the world. Manufactured only by the Electro-Magnetic Medical Plaster Company, Limited, 101, Piccadilly, Manchester." Here is




a sketch of the plaster :—A piece of coarse linen or canvas 7½ inches long × 5 inches wide, perforated, and having one side daubed over with the "vegetable extract" of a sickly green hue, and smelling badly. Stuck on the "extract" are two very thin pieces of copper and zinc foil, about 1¾ inches long and 1⅛ inches wide, connected together by an attenuated strip of the zinc. The ends of this strip are simply placed about an eighth of an inch under the pieces of metal foil, no attempt at soldering or good contact being made. This is all; the whole thing is not worth a penny piece. So the selling price—the 1s. 1½d. of patent medicine fame—leaves room for considerable profit. A correspondent sends the following additional testimony to that supplied by the company :—

It is useful for decorating a room—drawing-room preferred—as when used in sufficient numbers they prevent the Wall Paper from being injured by the gas, besides being a restful object for the Eye.

It will be Observed that the Celebrated "Short Circuit" current is here used. This saves the wear and tear of the Organism that Occurs when the electric Current passes through the Body.

Their beautiful Green colour will be found to harmonise with the Character of those Using them.

**Grimsby and Electric Lighting.**—The Town Council intend applying for a provisional order, and have appointed a sub-committee to go fully into the matter and get estimates from one or two contractors, so as to gain an idea as to the probable cost of electric lighting.

**Electric Launches for Venice.**—A Philadelphia paper considers that electric launches may supersede gondolas on the canals of Venice, as one result of the Columbian Exposition. One of the Chicago launches has already been sent to Venice by a company, which is said to include several members of the Royal Italian Commission. The company owning the boats at the Exposition says that the Italian company has an option on 30 of the 50 launches now in use at the World's Fair.

**Sulphuric Acid for Thermometers.**—According to the *Elect.-Techniker*, thermometers, having sulphuric acid for the expanding liquid, are coming into extensive use. They can indicate higher and lower temperatures than mercury and alcohol thermometers. Mercury solidifies at − 40° C., and sulphuric acid at − 112° C. Alcohol, on the other hand, vaporises at very ordinary temperatures, whilst sulphuric acid is very stable, possessing also the further advantage that its rate of expansion is constant over a wide range of temperature.

**Mutual Induction and Capacity of Circuits.**—Messrs. Bedell and Crehore have issued another paper, in the same style as their former communications; it treats of various problems concerned with circuits possessing mutual induction and capacity. The treatment of the subject they adopt is the same as that of their former papers, and is almost entirely of academic interest only, the subject being approached by the well-known equations made with the usual conventions. The chief use of these papers lies in having the solutions of the various cases thus collected together.

**Lectures.**—A series of lectures on electricity, by Mr. Briscoe, were commenced last week at the Peterborough School of Art.

On 26th inst., Mr. C. W. Kimmins, M.A., D.Sc., commenced a course of University lectures in the Mechanics' Hall, Scarborough, on "The Dawn and Progress of Science." His first part of the subject was "Progress in Methods of Lighting."

A series of lectures on "The Electric Current and its Modern Appliances," are to be given during the coming winter, under University Extension auspices, at Stroud.

**Municipal Discussions on Electric Lighting.**—If it were not for the ludicrous aspect, one would blush for the discussions which frequently take place on municipal electric lighting. Here is a specimen of municipal littleness: A special meeting of the Taunton Town Council met to discuss electric light matters, and the subject drifted into the following personal conversation:—After Alderman Standfast had complained of the secrecy practised by the committee, Councillor Sibley repudiated his insinuation, and contended that he had no right to make the charge. Mr. Standfast: You preach, but don't practice. Mr. Sibley: Don't be a bully. Mr. Standfast: Whom are you looking at? Mr. Sibley: At you. The recommendations of the committee were adopted.

**Chloride of Lead and E.P.S. Batteries.**—At the last meeting of the Société des Accumulateurs Electriques (Faure-Sellon & Volckmar), the shareholders voted the winding-up of the company, and authorised the board to transfer all their assets to the Société pour le Travail Electrique des Métaux. The Société des Accumulateurs Electriques had been formed in 1889, with a capital of 1,100,000 francs (£44,000), fully paid. The assets to be transferred on the following basis: each shareholder to receive as many £20 fully paid shares in equal number to the shares he holds in the French E.P.S. Company, and the liabilities, about £10,000, to be settled by a payment in shares. The Société pour le Travail Electrique des Métaux, created under the auspices of Messrs. de Rothschild, is the owner of the Laurent Cèly Patents for the manufacture of chloride of lead batteries, which are to be worked in this country by the Chloride of Lead Storage Company.

**Worcester Electric Lighting.**—Operations in connection with the erection of the electric lighting station at Powick Mills were commenced at the beginning of last month, and are said to be making very satisfactory progress.

**Scarcity of Water in Ireland.**—We understand that the Bessbrook and Newry Electric Tramway Company are only able to run a few tramcars every day owing to the scarcity of the water supply.

**Bath Electric Lighting.**—The electric light during the last few days has been giving rise to much dissatisfaction. One night the whole of the eastern circuit was in darkness for half an hour, while the night previous the western circuit was very unsatisfactory. The *Radstock Observer* remarks "probably the crisis in the coal trade has something to do with this!"

**Electrical Fête at Blackpool.**—The Blackpool Town Council have decided to hold a grand electrical fête on October 18th. The new arc lamps along the promenade will be lighted for the first time, and it is proposed to festoon the whole length with incandescent lamps. The tower will be outlined from top to bottom with incandescent lamps, surmounted by a group of arc lamps and a powerful search light. There is to be a cyclists' parade, the machines to be lit by electricity. There will also be a grand banquet, at which Lord Kelvin is expected to be present.

**The Electric Light at Lynmouth.**—At a meeting of the Lynton Local Board, last week, the surveyor reported that five oil lamps had been fixed on the Esplanade at Lynmouth, in lieu of electric lights. Subsequently, Mr. Benn attended, and made an offer of the electric works to the Board. The Board was already paying £143 for lighting, and if the Board would add another £50 to that amount, he would hand over the works and undertaking. He estimated that the working expenses amounted to about £250, and revenue from private consumers, £400. After the lapse of the 42 years, the property would become absolutely free to the Board. The consideration of the offer was adjourned.

**Willans Memorial Fund.**—We are asked to mention that the subscription lists for this Fund will be closed on November 1st, so that any engineers or others who intend to send in subscriptions, and have not done so, should do so at once. Mr. Alexander Siemens, 12, Queen Anne's Gate, Westminster, is the treasurer of the committee. It may be remembered that the proposal is to establish a fund in connection with the Institution of Mechanical and Electrical Engineers, from the interest of which a premium might be awarded for Papers relating to the subjects which the late Mr. Willans made so peculiarly his own.

**London County Council and Electric Light Loans.**—The London County Council on Tuesday agreed to loan £12,000 to the St. Pancras Vestry for electric lighting purposes. The Finance Committee have reported as follows:—"We have to report that we have been in communication with the Lords Commissioners of Her Majesty's Treasury with reference to the period over which loans for electric lighting purposes should be spread, and have now received a reply, dated July 29th, 1893, in which their lordships accept the view urged upon their consideration with regard to the absolute necessity of all appliances and work in connection with electric lighting being kept in a thoroughly efficient condition to perform its work, and the assurance that the Council would be advised by its professional officers on every application for a loan for electric lighting purposes, so that if any considerable portion of a loan was for short-lived purposes, the term for that portion would be considered, and the circumstances of each case taken into account. Subject to these observations, the Treasury agree that in the case of loans of this class, the whole initial cost may be taken into account in fixing the period of repayment, and that repayment may be spread over such period of years, not exceeding 50, as may seem appropriate in each case. We are glad that the Treasury has seen its way to agree to the request of the committee, as we consider that it will give increased facilities to the vestries and district boards in introducing electric lighting in their districts."

**West Ham and Electric Lighting.**—The Town Council have deferred consideration of the electric lighting question for six months.

**Fatal Accident.**—Joseph Till, an electrician, was at work on the top of a factory chimney at Long Eaton, when he overbalanced, and falling with great force on a stone paved yard, was killed on the spot.

**The Electric Light at Derby.**—The Mayor of Derby has invited the magistrates and Corporation to a banquet, to take place at the Royal Hotel on October 9th, to celebrate the installation of the electric light in the town.

**Disposal of Refuse.**—With reference to our comments on Mr. Warner's paper, published last week, we are informed that the destructors in use at Bournemouth and Newcastle are merely extensions of older types, and that the St. Luke's Vestry have not yet given the formal order for destructors.

**Keighley and Electric Lighting.**—Arrangements have been made for the Town Council to inspect the installations at Leeds, Bradford, Morecambe, and in other towns. It is estimated that the cost of a plant to supply the principal streets in Keighley would be from £15,000 to £20,000.

**Belfast Electric Lighting.**—The site selected for an electric light station is situated between Chapel Lane and Marquis Street. Intimation to this effect has been conveyed to Prof. Kennedy, with a request that he would at once prepare the specifications and plans for carrying out the work.

**The India-Rubber, Gutta-Percha and Telegraph Works Company, Limited.**—This company have just issued revised price lists of the "Electric Light Cables and Wires," "Galvanic Batteries," and "Dynamos" manufactured by them. The revisions have all been in the direction of reductions of prices. With reference to the electric light cables, the reductions have, in many cases, been made owing to the use of reduced thicknesses of rubber insulation. This diminution of thickness has not been made with the object of economy, but because experience has proved that the thickness hitherto employed is unnecessary. In the galvanic battery price list we observe that the ordinary porous pot form of Leclanché cell, No. 3 size, is supplied at the remarkably low sum of 1s., including the charge of sal-ammoniac. The Silvertown dynamos are manufactured in nine sizes, varying in output from 1,500 to 48,000 watts.

## CONTRACTS OPEN.

**Cairo.**—October 31st. Mr. N. J. Psiachi, contractor, of Cairo, invites tenders for the electric lighting of some buildings with about 1,500 glow lamps of 10 C.P., and 12 arc lamps of 350 C.P.

**Lancaster.**—October 11th. The Electric Lighting Committee are prepared to receive tenders for the brickwork, boiler seats, &c., required in the fixing of two Lancashire boilers and one set of Green's economisers at the Electricity Works, Marton Street Yard.

**St. Pancras.**—October 16th. The Vestry of St. Pancras are prepared to receive tenders for the building of chimney shaft at the East St. Pancras Central Station, King's Road, N.W.

## BUSINESS NOTICES, &c.

**The Universal Electrical Directory (J. A. Berly's),** now under the direct supervision of the proprietors, H. Alabaster, Gatehouse & Co., is in active preparation for the 1894 edition (13th year). This is a directory of the electrical trades embracing the whole Universe, and having no superfluous matter irrelevant to a directory it can be sent everywhere, carriage paid, for 4s. It is indispensable to all having business transactions in the electrical world, and once used cannot be done without. Advertise in it! Order it! It will prove the best outlay ever made.

**Camberwell and Electric Lighting.**—At a recent meeting of the Vestry, Mr. Wallace submitted the report of the General Purposes Committee upon the electric lighting scheme. He said they had received a report from Mr. E. Manville, and had viewed the systems in operation at Kensington, Knightsbridge and Southwark. It would be necessary for the Vestry, should they desire to adopt the scheme, to apply for a provisional order, the estimated cost of which would be about £800. If the Vestry obtained the order it would not bind them to undertake the supply themselves, for they could assign the same to a company if they chose. They recommended that the Vestry fix a time for Mr. Manville to give a public lecture, and "That should the Vestry desire to proceed further in this matter, a joint committee of 24 members be appointed, consisting of an equal number from the following four standing committees, viz., the General Purposes, Sewers and Sanitary, Finance, and Plant and Scavenging, to report further thereon, and recommend to the Vestry." This recommendation has been agreed to. Mr. Manville is of opinion that the high tension alternating current system will be the best adapted for Camberwell. High tension feeders can be carried from the generating station to those streets in which a demand for electricity is experienced. In these streets a system of low tension mains can be laid down which would be fed by the high tension feeders through transformers placed in boxes in the streets. This system will enable the Vestry to feel the pulse of the ratepayers by putting down in the first instance a comparatively small station. He considers it advisable, in the first instance, that a station should be erected capable of supplying 12,000 lamps of 8-candle-power, which, inclusive of the arc and incandescent lamps required for lighting the principal streets, would cost about £50,000. It would, however, be feasible for the Vestry to limit the initial amount to a lower sum than this. A station of this size produces at 6d. per unit a revenue of £6,000 per year, and the cost of generating and distributing the electricity, including repairs and maintenance, would be, assuming the dust was used for fuel, 3¾d. per unit—leaving a net profit of £2,250 towards paying the interest and sinking fund of the undertaking. Mr. Manville suggests that in applying to the electric lighting authority for the parish the Vestry should name the following streets as the compulsory area:—Rye Lane, Peckham Road, Church Street, Camberwell Green, Camberwell, Old Kent Road, Camberwell New Road, Queen's Road and High Street, Peckham. To light these streets with electricity would cost exactly double what it costs to light them by gas. But what the Vestry would have to pay extra it would gain in other directions. It is not going into the electric light business for these streets alone, and the more the streets are lighted with electricity the cheaper will be the cost. And when the shops, as Mr. Manville predicts, will cease the use of dim gas when the streets in front of them are brilliantly lighted with electricity the revenue of the Vestry will increase, and like St. Pancras, it will soon be lighting its streets for nothing. In connection with this scheme of electric lighting, Camberwell has an opportunity of profitably utilising its streets refuse, the disposal of which is now a vexatious problem. If the utilisation of street and ashbin refuse can be combined with generating electricity, then the saving to the Vestry will be at least 1½d. per unit. At present over 31,000 loads of refuse have to be got rid of at a cost exceeding 2s. 6d. per load. Now, with a well designed destructor the refuse could be got rid of for half that sum, and the heat utilised for generating electric light. By this system Mr. Manville says the Vestry could produce electric light at 1½d. per unit less than is paid by any company or municipality in the South of England.

**Ernest Scott & Mountain.**—We hear that this firm have contracted with the Lothian Coal Company, Newbattle Collieries, Dalkeith, near Edinburgh, for the supply of two electric pumping plants. The plant will consist of two compound horizontal condensing engines, each engine to be capable of giving 120 effective H.P. The engines will drive on to a main countershaft driving on to two "Tyne" dynamos, each capable of giving an output of 60,000 watts, and requiring 100 effective H.P. to drive. The current from these dynamos will be taken by two pairs of armoured cables to the pumps, which are placed at the bottom of the pit, and each set of pumps will be capable of delivering 200 galls. of water per minute against a head of 600 feet; the pumps being driven by "Tyne" electric motors, each capable of giving 60 effective H.P. The pumps will be of the three-throw ram type, the rams being 7½ inches diameter by 12 inches stroke, and the general design of the pumps will be in accordance with Messrs. Scott & Mountain's latest practice in this class of machinery, the pumps all being independent with independent valve boxes, thus providing against any possible breakage of either of the pumps or valve boxes. The same firm are just completing for the Shilbottle Coal Company, a set of three-throw pumps capable of delivering 200 gallons of water per minute against a head of 200 feet. In addition to this, the firm supplied about 12 months since to the North Seaton Colliery a set of three-throw ram pumps, capable of delivering 300 galls. of water per minute. These pumps have run for the last 12 months, practically day and night, and have given great satisfaction to the directors and officials of the Cowpen Coal Company.

**Temporary Electric Lighting.**—We understand that Messrs. Bilbie, Hobson & Co., the well known London agents for the "Stockport" gas engine, have made arrangements to light the whole of the Agricultural Hall, Islington, during the coming Brewers' Show, the Confectioners' Exhibition, and the Stanley Club Show, by arc lights. The installation will be driven by a 20 H.P. nominal Stockport gas engine, "Otto" cycle, developing about 43 H.P. brake. This engine will be fitted with a special electric light governor and non-corroding tube ignition, and in connection with this ignition is a self-starter, for which it is claimed that it needs no skilled attention whilst being effective. The Brush dynamo and the wiring and fittings will be carried out by Messrs. Vaughan & Brown, of Kirby Street, Hatton Garden.

**Bedford Electric Lighting.**—The Town Council held a stormy meeting last week regarding the electric lighting question. It is a great pity that so much personal feeling is exhibited at the meetings of local authorities. Taunton has figured very conspicuously in this direction, and now Bedford councillors have followed in their footsteps. In response to advertisements three firms estimated for the electric lighting installation. Mr. F. H. Medhurst, of Cambridge, made two alternative propositions: (*a*) A proposition to transfer to himself, under certain conditions, the provisional order; (*b*) A proposition to erect, for the sum of £24,000, a complete installation. An approximate estimate from Messrs. C. A. Parsons & Co., of Newcastle-on-Tyne, for laying a plant at a cost of £12,000, exclusive of buildings. The Bedford Electric Light Company, Limited, stated the conditions under which they would be willing to undertake and carry out the said order. The electric lighting committee have carefully considered the applications, and are of opinion that it would not be judicious to entrust a work of such importance to a private individual: Messrs. Parsons's offer, they consider, does not comply with the terms of the advertisement. The only application that fully conforms to the terms of the advertisement is that of the Bedford Electric Light Company, Limited. Nine members voted in favour of this and eight against, so that by a majority of one the order is to be handed over to a private company. There is likely to be some further noise about the matter at Bedford.

**Electrical Engineers and Stoker-Mechanics.**—Wanted for the training ship *Shaftesbury*, off Grays, Essex. The following:—An electrical engineer, having a practical kno[illegible]ge of engines, dynamos, accumulators, steam boilers, &c., is wanted for the training ship *Shaftesbury*, off Grays, Essex. Commencing salary £65 a year, with uniform, board, &c. Stoker-mechanic, having a practical knowledge of electric lighting apparatus and steam boilers; also capable of doing general repairs to pumps, cooking and other apparatus. Commencing salary £50 a year, with uniform, board, &c. Applications, on forms to be obtained from the School Board Offices, accompanied by copies of not more than three testimonials, must state age and previous experience, be marked outside "Electrical Engineer," or "Stoker-Mechanic," as the case may be, and be received by the Clerk of the Managers, School Board Offices, Victoria Embankment, London, W.C., on or before Friday, the 13th instant.

**Dundee Electric Lighting.**—At a meeting of the Works Committee of the Dundee Gas Commission held recently, the Convener stated that a student from Faraday House, desirous of acquiring a knowledge of electric lighting station work, offered a premium of £50 per annum to the Commissioners to be allowed to do so at the electric lighting station, Dundee. The meeting agreed to permit this on the first year's premium being paid in advance. The Sub-Committee, anent the checking of accounts, recently reported that they had examined and passed accounts for coals to the amount of £1,751 5s. 8d., for sundries to the amount of £252 12s. 9d., and for electric lighting accounts to the amount of £241 4s. The Finance Committee were recommended to issue cheques for the payment of these accounts.

**Bad Navigation of Electric Launches on the Thames.**—Mrs. Dora Naghten, of Maidenhead Court, has been summoned by order of the Thames Conservancy for having navigated the electric launch *Mu* without due care and caution. From the evidence it appeared that the defendant was on board the launch, which was being navigated by a lad, when the launch ran into a skiff occupied by Mr. R. H. Linden, of 79, Grosvenor Street, London, and his sister, the latter being thrown on her back by the collision. The rail at the back of the skiff was smashed. Mr. Linden asked the defendant for her name and address, but she refused to give them. The defendant was fined £5 with £1 17s. 6d. costs. A summons against John Fennell for a similar offence in respect of the steam launch *Lodore* was adjourned.

**Rotherhithe Vestry and the London Electric Supply Corporation.**—At Rotherhithe Vestry, on Tuesday evening, Mr. Thomas, Surveyor of Pavements, reported that the London Electric Supply Corporation were taking up the road in different parts of the parish, especially in Raymouth Road, and failed to reinstate them properly. He asked for instructions. Mr. Brown, a vestryman, supported the surveyor's statement, and referred especially to Rotherhithe New Road. On the previous Saturday they commenced work there, and continued all through Sunday. The road was almost entirely blocked, and accidents had occurred there in consequence. Great inconvenience had been caused to the inhabitants and shopkeepers. The clerk was ordered to write a strong letter to the company on the subject.

**Re Incandescent Lamp Works, Brook Green.**—We have been further informed that these works have been acquired and started by a new company—the Incandescent Electric Lamp Company—for the purpose of manufacturing Robertson's incandescent lamps. The directors of the company are Mr. James Fraser, Mr. G. Binswanger and Mr. C. Robertson, whilst the last gentleman will direct the manufacture of the lamps. The General Electric Company, who are largely interested in the new company, are undertaking the sale of the whole output of the works.

**Norwich Electric Lighting.**—The Secretary of the Norwich Electricity Company, Limited, has announced that on and after October 1st, those consumers who, up to the present time have been supplied with electricity by Messrs. Laurence, Scott and Co., will be supplied by the Norwich Electricity Company, Limited, and all applications for current in future must be made to the secretary of the company. The directors are now considering the further extension of mains.

**Electric Lighting in Queensland.**—The Rockhampton Gas and Coke Company, Limited, have a sole right to supply in Central Queensland electricity for lighting and power purposes under Act of Parliament (Queensland), granted November 6th, 1889, provided this has been carried out within 5 years. The work has now been accomplished, and has been assented to by the local authorities. The central station has, at present, a capacity of 2,000 8-C.P. lamps, 1,000 on low tension, 1,000 on high tension. The total number of 8-C.P. lamps in use, wired up, is 914 8-C.P., the total number on order being 1,700. The boilers are Roots water-tube with Knap's patent joints; the engines are Davey-Paxman and Westinghouse; the dynamos are Hookham's patent, by Chamberlain & Hookham, Limited, for the low tension system, Mordey "Victoria" alternating system by Brush Company for high tension system. The Fitzroy bridge is lighted by alternate current arcs; the mains are all underground, on Callender's solid system; current is charged by meter, and fixed charges; Hookham's meters are in use; the central station recording instruments are by Richard Frères. The Rockhampton Company also undertake isolated installations, and are doing all the electrical work for the Mount Morgan G. M. Company's Plant consisting of 60 arc lamps "Brockie-Pell" series 10 ampères, 120 16-C.P. incandescence, a 50-light and 25-arc dynamo (Kapp), and 10-unit "Crompton" incandescent. The same company are engaged as consulting engineers for "Clermont" electric lighting.

**Lancaster Electric Lighting.**—The Town Council have given directions for a lightning conductor to be fixed on the chimney of the electricity works by Messrs. Cross, of Smethwick, near Birmingham, at the price of £9 10s. The tender of Mr. Thomas Blocksage, of Dukinfield, for the fire-clay cap for the chimney, at £18 10s., has been accepted. The surveyor at the last meeting submitted correspondence which had taken place between Messrs. Manlove, Alliott & Company and himself, from which it appeared that Messrs. Manlove, Alliott & Company had made an error in their tender for the erection of the wrought-iron roof over the chimney and boiler-house at the electricity works, and that they were not prepared to carry out the work for the amount originally named by them, viz., £95. Resolved: that the tender of Messrs. Brownlow & Murray, of Glasgow, be accepted for carrying out the above work, at the price of £95.

**Personal.**—Mr. C. J. Robertson has retired from his partnership and duties as technical director to the "Watt" Glow-lamp Factory of Vienna, and has now joined the Incandescent Electric Lamp Company, Limited, of Brook Green Works, Hammersmith, W., as their engineer and managing director.

Mr. J. W. Manley has resigned his position as chief engineer to Messrs. Julius Sax & Co.'s Smithfield Markets Works in order to start in business upon his own account.

Mr. Lee has been appointed engineer to the Southampton Electric Light and Power Company, Limited, in place of Mr. K. A. Scott Moncrieff, who has left to join Messrs. Kilburn & Co., the Calcutta agents to Crompton & Co., Limited.

**The Telephone at Cleckheaton.**—At a recent meeting of the Cleckheaton Chamber of Commerce a member reported that he and Mr. Law had waited upon the officials of the National Telephone Company at Leeds, and laid before them the Chamber's request that the company's Cleckheaton subscribers should have the option of being connected with either the Bradford or Dewsbury centres. They were told that when the Government took over the trunk wires they had to divide the country into areas, and Leeds, Bradford, and Dewsbury were separate areas, Cleckheaton being on the fringe of the Dewsbury area. The Chamber's request should, however, have attention, and the head officials of the company be communicated with.

**Portishead Lighting.**—At the last meeting of the Local Board it was stated that in reply to the advertisement for lighting tenders, three tenders were received for doing the work with electricity, by oil, and by gas. The electrical tender was somewhat technical, and suggested the purchase of plant to the amount of £12,450. The oil tender was said to work out to £2 4s. 6d. per lamp. The offer of the Portishead Gas Company was £2 2s. per lamp. A member of the Board thought they would, before long, see electricity introduced. Keynsham was wonderfully pleased with its electric light, and it cost less than the lighting at Portishead, where gas was used. It was resolved that the tender of the Gas Company be accepted.

**Kensington Vestry and Electric Lighting.**—The Works Committee of the Kensington Vestry have considered a letter from the House-to-House Electric Light Supply Company, stating that the company were desirous of using conduits formed of bitumen or adamant stone, and asking that in lieu of the deposit of £300 upon the commencement of the works as required by the Vestry, they might be allowed to pay a sum sufficient to cover the cost of the reinstatement of each section of the works as the same progressed. The committee recommended that this request be agreed to, but that iron pipes be insisted on where the mains were laid under the carriage way. The recommendation was adopted by the Vestry.

**Sunderland Electric Lighting.**—A committee of the corporation last week considered the report of Prof. Kennedy on the scheme of electric lighting for some of the principal streets. The report suggested specifications for plant and sets of plans of the work. There are ten sets of plans, and the committee decided to obtain 20 copies of each at a cost of £20. They also decided to have complete specifications made out in accordance with Prof. Kennedy's suggestions, and also to advertise for tenders from electrical engineers supplying and fixing plant. The Dunning Street Hospital is intended to be used as the central station.

**Elmore's Foreign and Colonial Patent Copper Depositing Company, Limited.**—On Wednesday last, before Mr. Justice Kennedy, sitting as Vacation Judge, counsel on behalf of General Sir Richard J. Meade, a creditor for an amount not mentioned, presented a petition for winding-up. Mr. Ashton Cross (interposing) said he was instructed to ask his lordship to allow of an adjournment for a reasonable time, in order to enable a scheme to be carried out. They had secured creditors for about £25,000 in approval, there being in opposition only some £1,500. Counsel appearing for the largest creditor said he was instructed to support the application for a two months' adjournment, and counsel for the company supporting this, his Lordship said the case had better be adjourned accordingly.

**Electric Lighting at Tweedmouth.**—Messrs. Allan Brothers are having their Tweed sawmills fitted throughout with the electric light. A Parsons steam turbine and dynamo has been furnished to supply the electric energy, and altogether in the various shops and offices there will be nearly 200 incandescent lights. The installation is being arranged by Messrs. A. A. C. Swinton & Co. The light was turned on for the first time on Monday, last week.

**Dolgelly Electric Lighting.**—At a recent meeting of the Local Board, an instalment of £40 towards the cost of lighting the town was asked for. The matter was adjourned to the next meeting. The committee recommended that the board should send in a complaint that the light was of inferior quality. The company gave an explanation to the effect that the cause of the complaint was owing to the inferior coal.

**Picture Gallery Lighting.**—Messrs. Drake & Gorham, who, it will be remembered, have opened a permanent branch in Manchester, have been entrusted with the lighting of Messrs. Agnew and Sons' well known picture gallery, by means of about 160 lights. Special attention is being given by the contractors to the picture reflectors, the effect of which is, of course, the most important part of the work.

**Great Missenden Electric Lighting.**—The authorities have adopted a proposition of the British Volta Electric Glow Lamp Company to provide electric lighting plant and fittings at their own cost, and also to provide 13 electric lights each night, from September to March, for all hours from one hour after sunset to 10·15 p.m., on condition that the charge to the village shall not exceed £15 per year.

**Lewisham Infirmary Lighting.**—Mr. Harston, the architect to the Lewisham Board, has estimated the cost of lighting the new infirmary by electricity. He puts the cost of installation down at £5,000, the maintenance at about the same, or a slightly higher figure than for gas, which he estimated to cost £250 for lighting, apart from cooking. The Board have decided to light the infirmary by gas.

**Shoreditch Guardians and the Telephone.**—The Shoreditch Board of Guardians have decided to accept an offer from the National Telephone Company to connect their premises with the Metropolitan Exchange system, on a five years' agreement, at £17 per annum. The offer submitted was £20 per annum on a yearly agreement, or £17 per annum on a five years' agreement.

**Private Installation at Glasgow.**—With a view to keeping abreast of the times, Mr. John Anderson of the Royal Polytechnic, Glasgow, has just had his warehouse fitted up with electric light. The installation comprises 38 Crompton arc lamps, eight of these being placed outside the building. The installation was fitted up by Messrs. Norman & Son, Limited.

**Electric Light in St. Olave's.**—At the meeting of St. Olave's Board of Works on Tuesday, Mr. Shand moved that electric light be provided for the new Board offices being erected in Vine Street. Mr. Shand urged that the electric light would be a great boon, and would not cost much, as the Board had its own engine. The motion was carried.

**Electric Lighting of Municipal Buildings.**—The Technical Instruction and Public Library Committee have agreed to the lighting of the Institute building by electricity, and asked the sanction of the council to the acceptance of the tender of Messrs. Benson & Co., of London, for carrying out the wiring of the building for £314.

**Electric Light at Woking.**—The Woking Electric Supply Company have recently added two powerful steam engines and one more dynamo to their works. Another dynamo has also to be supplied. This extra machinery will enable the company to double their production, and has been necessitated by the great increase in the consumption which has taken place. Messrs. New & Mayne, the contractors for the fittings, &c., are engaged on the work.

**Taunton Electric Lighting.**—A special meeting of the Town Council was held on Monday to receive and consider a report of the Electric Light Committee, to affix the seal of the borough to the contract with the electric light company, for the purchase of the works, and to make arrangements with respect to the new loans, &c.

**Electric Lighting at Torquay.**—At a recent meeting of Upton Ward burgesses, the following resolution was passed:—"That this meeting hopes that when the time comes for the general introduction of the electric light, our representatives will do their best to obtain public control of the same for the public good."

**Penrith Electric Lighting.**—An electric lighting provisional order is to be applied for by the local authorities.

**The Tayler-Smith Electric Company.**—This firm has just completed the lighting of the Vintners' Hall and buildings with some 260 lamps. The work has been carried out somewhat upon the lines of the Merchant Taylors' Hall, which was installed by the Tayler-Smith Company at the beginning of the year.

**Electric Lighting of Bank Premises.**—The new premises of the London and Midland Bank at Bradford, are to be lighted by electricity. There are 45 16-C.P. lamps. Owing, however, to the great demands on the Corporation supply, the premises cannot be supplied with current until November.

**Dover Electric Lighting.**—At a recent meeting of the Town Council, Mr. Sellons and Mr. Lawson, from the Brush Company, with Mr. Martyn Mowll, attended and explained the proposed memorandum and articles of association and prospectus of the Dover Electric Supply Company.

**Electric Lighting at Folkestone.**—The General Purposes Committee have included in their various payments a sum of 50 guineas, the amount due to Mr. Mark Parker for preparing a report for the corporation on the electric lighting question.

**Breaking Electric Lamps.**—Some persons who were charged with breaking two electric lamp globes, the property of Messrs. R. H. Fell & Co., of Troutbeck Bridge, were let off on agreeing to pay the amount of the damage done.

**Chelsea Workhouse and Electric Lighting.**—The Chelsea Electric Supply Company wrote offering to supply the Chelsea Workhouse and Guardians' offices with the electric light. The guardians have refused the offer.

**Church Electric Lighting.**—It has been decided to light the Broadmead Baptist Chapel by electricity. The installation has been entrusted to Messrs. J. S. Willway & Sons, electrical engineers, Bristol.

**Notice of Removal.**—The Scottish Gas Stove Company have removed from 105-6, High Holborn, to more central and convenient premises at 22, Garlick Hill, Queen Victoria Street, E.C.

## CITY NOTES.

### International Electricity Company of Vienna.

The present report of this company is remarkable for the small sum allotted to the reserve and to the sinking funds. Dividends of 5½ per cent. should not be paid under such circumstances. We must also wonder at the small number of 17 electro-motors in Vienna, along with 50,000 lamps. This may be in connection with the alternating current system. Last year the company had 9 electro-motors to about 32,000 lamps. The fundamental tax, which increased the cost of electric lighting and thus prevented its general extension in Vienna, has been reduced with the best effect for the introduction of the electric light in dwelling houses.

**Brazilian Submarine Telegraph Company, Limited.**—The accounts of this company, subject to audit, show a profit sufficient to enable the directors to recommend a final dividend of 3s. per share, making with previous distributions a total dividend of 6 per cent. for the year ended June 30th, 1893, and also the payment of a bonus of 1s. per share, both free of income tax, which together will amount to £26,000, leaving a balance of £10,533, of which amount £7,000 has been placed to the reserve fund, increasing that fund to £638,675, and £3,533 carried forward. For the purpose of paying the above dividend and bonus on the 19th inst., the register of transfers will be closed from the 10th to the 18th instant, both days included.

**Petroleum Engine Company, Limited.**—A meeting of this company was held on Wednesday afternoon at 23, Queen Victoria Street, E.C. The proceedings were private, representatives of the press not being admitted.

**Henley's Telegraph Works Company, Limited.**—Dividend warrants have been posted for the half-yearly interim dividend on the preference shares at the rate of 7 per cent. per annum.

## TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending October 1st, 1893, amounted to £795; week ending October 2nd 1892, £786; increase £9; total receipts for half-year, 1893, £10,449 corresponding period, 1892, £9,994; increase £455.

The Cuba Submarine Telegraph Company. The estimated traffic receipts for the month of September were £3,000; as compared with £3,295 in the corresponding month of last year.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of September, 1893, amounted to £1,865, against £2,011 in the corresponding period of last year.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending September 29th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brasilian Telegraph Company, Limited, were £9,514.

## SHARE LIST OF ELECTRICAL COMPANIES.

| Present Issue. | Name. | Stock or Share.‡ | Closing Quotation September 27th. | Closing Quotation, October 4th. | Business done during week ended October 4th, 1893. Highest. | Lowest. |
|---|---|---|---|---|---|---|
| 184,500£ | African Direct Telegraph, Ltd., 4 p. c., Deb. Rcgd. and to Bearer | 100 | 99 —102 | 99 —102 | 100 | ... |
| 1,134,640£ | Anglo-American Telegraph, Limited ... ... ... ... ... | Stock | 50 — 51 | 50 — 51 | ... | ... |
| 2,932,680£ | Do. do. 6 p. c. Preferred ... ... ... ... ... | Stock | 92 — 93 | 92 — 93 | 93 | 92½ |
| 2,932,680£ | Do. do. Deferred ... ... ... ... ... | Stock | 9½— 9⅝ | 9½— 9⅝ | 9⅝ | 9 5/16 |
| 130,000 | Brazilian Submarine Telegraph, Limited ... ... ... ... | 10 | 11½— 12 | 11½— 12 | 11⅝ | ... |
| 18,700£ | Do. do. 5 p. c. Bonds ... ... ... ... ... | 100 | 99 —103 | 100 —103 | ... | ... |
| 75,000£ | Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ... | 100 | 107 —111 | 107 —111 | ... | ... |
| 77,978 | Brush Electrical Engineering Ordinary, Nos. 1 to 63,416 ... ... | 3 | 2⅞— 3⅛ | 2⅞— 3 | 3 | ... |
| 75,000 | Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416 | 2 | 2⅛— 2⅜ | 2⅛— 2⅜ | 2 5/16 | 2 3/16 |
| 125,000£ | Do. do. 4½ per cent. Debenture Stock ... ... | Stock | 107 —109 | 107 —109 | ... | ... |
| 20,510 | Charing Cross & Strand Electricity Supply Nos. 1 to 6, 215 to 718, and 10,001 to 30,000 | 5 | 5 — 5⅛ | 4⅞— 5⅛ | ... | ... |
| 44,000 | Chili Telephone, Limited, Nos. 1 to 40,000 ... ... ... ... ... | 5 | 2 — 3 | 2 — 3 | ... | ... |
| 630,000£ | City and South London Railway ... ... ... ... .. | Stock | 34 — 36 | 30 — 35 | 30 | ... |
| 40,000 | City of London Elec. Lighting Co., Ltd., Ord. 40,001-80,000 ... | 10 | 11½— 11⅝ | 11½— 11⅝ | ... | ... |
| 20,000 | Do. do. 6 p. c. Cum. Pref., Nos. 1 to 20,000 | 10 | 12½— 13 | 12⅝— 13⅛ | 13⅛ | 13 |
| $7,716,000 | Commercial Cable, Capital Stock ... ... ... ... ... | $100 | 135 —140 | 135 —140 | ... | ... |
| 224,850 | Consolidated Telephone Construction and Maintenance, Limited ... | 10/- | 1/16— 3/16 | 1/16— 3/16 | ... | ... |
| 20,000 | Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos. 1 to 20,000 | 5 | 3½— 4⅛ | 3½— 4⅛ | 4⅛ | ... |
| 50,000£ | Do. do. 5 p. c. 1st Mort. Debs., 1—400 of £100, and "A" 1—200 of £50 each | ... | 98 —102 | 96 —101 xd | ... | ... |
| 16,000 | Cuba Telegraph, Limited ... ... ... ... ... ... | 10 | 11 — 12 | 11 — 12 | 11⅛ | ... |
| 6,000 | Do. do. 10 p. c. Preference ... ... ... ... | 10 | 18 — 19 | 18 — 19 | 18 1/16 | ... |
| 12,931 | Direct Spanish Telegraph, Limited, ... ... (£4 only paid) | 5 | 2½— 3⅛ | 2½— 3⅛ | ... | ... |
| 6,000 | Do. do. 10 p. c. Preference ... ... ... | 5 | 8½— 9⅛ | 8½— 9⅛ | ... | ... |
| 60,710 | Direct United States Cable, Limited, 1877 ... ... ... ... | 20 | 11⅜— 11⅝ | 11⅜— 11⅝ | 12 | 11⅜ |
| 400,000 | Eastern Telegraph, Limited, Nos. 1 to 400,000 ... ... ... | 10 | 15 — 15½ | 15 — 15½ | 15½ | 15 1/16 |
| 70,000 | Do. 6 p. c. Preference ... ... ... ... ... | 10 | 16 — 16½ | 16 — 16½ | 16⅜ | 16⅛ |
| 105,900£ | Do. 5 p. c. Debs. (1879 issue), repay. August, 1899 | 100 | 106 —109 | 106 —109 | ... | ... |
| 1,294,100£ | Do. 4 p. c. Mortgage Debenture Stock ... ... | Stock | 112 —115 | 112 —115 | ... | ... |
| 250,000 | Eastern Extension, Australasia and China Telegraph, Limited ... | 10 | 15½— 15⅝ | 15½— 15⅝ | 15½ | 15½ |
| 62,700£ | Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326 | 100 | 102 —105 | 102 —105 | ... | ... |
| 222,800£ | Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ... | 100 | 102 —105 | 102 —105 | ... | ... |
| 320,000£ | Do. 4 p. c. Debenture Stock ... ... ... ... ... | Stock | 110 —113 | 111 —114 | 112½ | ... |
| 108,700£ | Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343 | 100 | 101 —104 | 101 —104 | ... | ... |
| 146,800£ | Do. do. do. to bearer, Nos. 2,344 to 5,500 | ... | 101 —104 | 101 —104 | ... | ... |
| 300,000£ | Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909 | 100 | 101 —104 | 101 —104 | 102½ | ... |
| 200,000£ | Do. 4 p. c. Reg. Mt. Debs. (Mauritius Subsidy) 1 to 8,000 | 25 | 103 —106 % | 103 —106 % | 105⅜ | 105 |
| 49,900 | Electric Construction, Limited, Nos. 101 to 45,100 ... ... ... | 10 | 1½— 1⅝ | 1½— 2 | ... | ... |
| 19,900 | *Electricity Supply Co. of Spain, Nos. 101 to 20,000 ... ... ... | 5 | ... ... | ... ... | ... | ... |
| 100,000 | Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750 | 2 | ⅛— ¼ | ⅛ — ¼ | ... | ... |
| 91,195 | Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ... | 2 | ⅛— ⅜ | ⅛ — ⅜ | ... | ... |
| 67,385 | Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd. | 2 | ⅛— ⅜ | ⅛ — ⅜ | ... | ... |
| 20,000 | Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid) | 5 | 1 — 2 | ½ — 1½ | ... | ... |
| 180,227 | Globe Telegraph and Trust, Limited ... ... ... ... ... | 10 | 9⅜— 9⅞ | 9⅜— 9⅞ | 9⅞ | 9 3/16 |
| 180,042 | Do. do. 6 p. c. Preference ... ... ... | 10 | 15⅜— 15⅝ | 15½— 15⅝ | 15½ | 15½ |
| 150,000 | Great Northern Tel. Company of Copenhagen ... ... ... | 10 | 20 — 20½ | 20 — 20½ | ... | ... |
| 200,000£ | Do. do. 5 p. c. Debs. (issue of 1883) ... | 100 | 103 —106 | 103 —106 | ... | ... |
| 12,134£ | Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ... | 10 | 4½— 5½ | 4½— 5½ | ... | ... |
| 9,600£ | Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000 | 10 | 6 — 7 | 6 — 7 | ... | ... |
| 50,000 | India-Rubber, Gutta Percha and Telegraph Works, Limited .. | 10 | 21½— 22½ | 21½— 22½ | ... | ... |
| 200,000£ | Do. do. 4½ p. c., Deb., 1896 ... ... ... | 100 | 101 —103 | 101 —103 | ... | ... |
| 17,000 | Indo-European Telegraph, Limited ... ... ... ... ... | 25 | 39 — 42 | 39 — 42 | 40½ | ... |
| 11,334 | International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000 ... ... | 10 | 1 — 2 | 1 — 2 | ... | ... |
| 30,000 | †Liverpool Electric Supply, £3 10s. paid ... ... ... ... | 5 | 4⅛— 4¼ | 4⅛— 4¼ | 4 7/16 | 4 1/16 |
| 15,000 | Do. do. fully paid ... ... ... ... | 5 | 6 — 6¼ | 6 — 6¼ | 6⅛ | 5⅞ |
| 37,500 | Liverpool Overhead Railway Ordinary, fully paid ... ... ... | 10 | 5¼— 5⅜ | 5¼— 5⅜ | 8¼ | 4⅜ |
| 6,295 | Do. do. Pref., £4 paid ... ... ... | 10 | ... ... | 4 1/16— 4 3/16 | 4⅛ | ... |
| 37,548 | London Platino-Brazilian Telegraph, Limited ... ... ... | 10 | 4 — 6 | 4 — 6 | ... | ... |
| 100,000£ | Do. do. do. 6 p. c. Debentures ... ... ... | 100 | 105 —108 | 105 —108 | ... | ... |
| 49,900 | *Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid) | 10 | 6¾— 7¼ | 6⅞— 7¼ | ... | ... |
| 50,000£ | Do. 5 p.c. debentures, 1 to 5,000 in bonds of £10, £20, £40 | ... | 104 —107 | 104 —107 | 105½ | 105 |
| 15,000 | Monte Video Telephone Co., Ord., Nos. 1 to 15,000 fully paid ... | 5 | 1½— 2⅛ | 1½— 2⅛ | ... | ... |
| 28,000 | Do. do. 6 p. c. Pref., Nos. 1 to 28,000 fully paid | 5 | 3 — 4 | 3 — 4 | ... | ... |
| 458,867 | National Telephone, Limited, Nos. 1. to 438,984 ... ... ... | 5 | 4⅝— 4⅞ | 4½— 4⅝ | 4 13/16 | 4⅝ |
| 15,000 | Do. 6 p. c. Cum., 1st Preference ... ... ... | 10 | 14 — 15 | 14 — 15 | 14† | ... |
| 15,000 | Do. 6. p. c. Cum. 2nd Preference ... ... ... | 10 | 13½— 14½ | 13½— 14½ | ... | ... |
| 90,950 | Do. 5 p. c. Non-cum. 3rd Pref., Nos. 1 to 90,950 ... | 5 | 5½— 5⅝ | 5⅝— 5⅝ | 5⅝ | 5 5/16 |
| 726,477£ | Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ... | ... | 112 —114 | 112 —114 | 113½ | ... |
| 48,800 | New Telephone, Limited, Nos. 25,901 to 74,700 ... (£2 paid) | 10 | ... ... | ... ... | ... | ... |
| 6,452 | Notting Hill Electric Lighting Company, Limited, fully paid ... | 10 | 5 — 6 | 5 — 6 | ... | ... |
| 220,000 | Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid) | 1 | 3/16— 5/16 | ¼— ⅜ | ¼ | ... |
| 100,000£ | Pacific and European Tel., Ltd., 4 p. c. Guar. Debs., Nos. 1 to 1,000 | 100 | 101 —104 | 101 —104 | 102⅜ | 102½ |
| 11,802 | Reuter's Limited ... ... ... ... ... ... ... ... | 8 | 4½— 5½ | 4½— 5½ | ... | ... |
| 19,980 | St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780 | 5 | 6½— 6¾ | 6½— 6⅝ | 6⅝ | 6 7/16 |
| 20,000 | Do. do. 7 per cent. pref., Nos. 20,081 to 40,080 | 5 | 7¼— 8¼ | 8 — 8½ | ... | ... |
| 3,381 | Submarine Cables Trust ... ... ... ... ... ... | Cert. | 115 —120 | 116 —121 | ... | ... |
| 78,942 | Swan United Electric Light, Limited ... ... (£3½ only paid) | 5 | 2 — 2½ | 2 — 2½ | ... | ... |
| 37,350 | Telegraph Construction and Maintenance, Limited ... ... ... | 12 | 32 — 34 | 32 — 34 | ... | ... |
| 150,000£ | Do do. do. 5 p. c. Bonds, red. 1894 | 100 | 101 —104 | 101 —104 | ... | ... |
| 58,000 | United River Plate Telephone, Limited ... ... ... ... | 5 | 2 — 2½ | 2 — 2½ | ... | ... |
| 146,370£ | Do. do. 5 p. c. Debenture Stock ... | Stock | 90 —100 | 90 — 100 | ... | ... |
| 15,609 | West African Telegraph, Limited, Nos. 7,501 to 23,109 ... ... | 10 | 5½— 6½ | 5½— 6½ | ... | ... |
| 260,900£ | Do. do. do. 5 p. c. Debentures ... ... | 100 | 97 —100 | 98 —101 | ... | ... |
| 30,000 | West Coast of America Telegraph, Limited ... ... ... ... | 10 | 2 — 3 | 2 — 3 | ... | ... |
| 150,000£ | Do. do. do. 8 p. c. Debs., repayable 1902 ... | 100 | 97 —101 | 98 —102 | ... | ... |
| 64,242 | Western and Brazilian Telegraph, Limited ... ... ... ... | 15 | 6½— 7 | 6½— 7 | ... | ... |
| 33,129 | Do. do. do. 5 p. c. Cum. Preferred ... ... | 7½ | 5⅞— 6¼ | 5⅞— 6¼ | ... | ... |
| 33,129 | Do. do. do. 5 p. c. Deferred ... ... ... | 7½ | 1 — 1½ | 1 — 1½ | 1½ | ... |
| 178,200£ | Do. do. do. 6 p. c. Debentures "A," 1910 ... | 100 | 103 —106 | 103 —106 | ... | ... |
| 222,700£ | Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910 | 100 | 103 —106 | 103 —106 | 104⅜ | ... |
| 88,321 | West India and Panama Telegraph, Limited ... ... ... | 10 | 1½— 1⅝ | 1½— 1⅝ | 1½ | 1 5/16 |
| 34,563 | Do. do. do. 6 p. c. 1st Preference ... | 10 | 10 — 10½ | 10 — 10½ | 10⅜ | 10 |
| 4,669 | Do. do do. 6 p. c. 2nd Preference ... | 10 | 9 — 10 | 9 —10 | 9⅝ | 9½ |
| 80,000£ | Do. do. 5 per cent debentures (1917) No. 1 to 1,000 | 100 | 106 —109 | 106 —109 | ... | ... |
| $1,214,000 | Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds | $1,000 | 115 —120 | 115 —120 | ... | ... |
| 169,000£ | Do. do. 6 p. c. Sterling Bonds .. ... ... | 100 | 101 —104 | 101 —104 | ... | ... |
| 69,900 | *Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ... | 5 | 5 — 5⅛ | 5 — 5⅛ | 5⅛ | 5⅛ |

* Subject to Founders' Shares. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

**LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:**—Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5—5½.—Brush Company, 4½ per cent. Debenture Stock, issued at 1 per cent. premium, 100—103.—Electric Construction Corporation 6 per cent. Debentures, 95—98.—Electric and General Investment, shares of £5 (£1 paid), 1⅛—1⅜.—Founders' shares, 200—225.—Electricity Supply Corporation, Ordinary of £5, 5—5½.—House to House Company (£5 paid) 1½—2½.—Do. 7 per cent. Preference of £5, 5—5½.—Do. 6 per cent. Debentures of £100, 97—102.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 5⅝—5⅞, 1st Preference Cumulative 6 per cent., £5 (fully paid) 6—6½.—Manchester, Edison and Swan Company £9 (£1 paid), ⅛—⅜.—Queen Anne's Mansions Lighting and Heating 6 per cent. £100 Debentures, 101—103.

Bank rate of discount, 3½ per cent. (September 21st, 1893.)

## THE BRITISH ASSOCIATION.

### SELF-EXCITING ARMATURES FOR CONTINUOUS CURRENT DYNAMO-ELECTRIC MACHINES AND COMPENSATORS FOR LOSS OF PRESSURE IN FEEDERS OF ELECTRIC SUPPLY SYSTEMS.

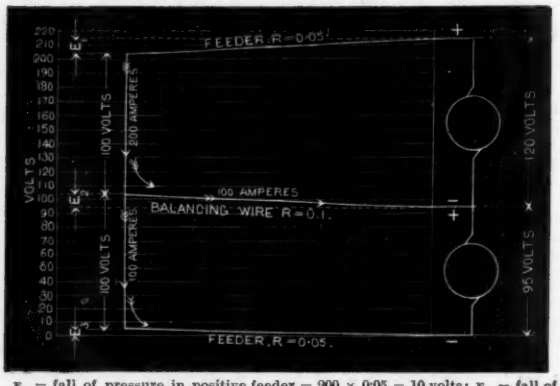
By W. B. Sayers.

(*Abstract of paper read before Section G, September 15th*, 1893.)

The object of this paper is to bring before the notice of the Association a new construction of continuous-current dynamo machine, in which that portion of the winding of the armature which, for the time being, is not subject to the inductive action of the magnetic field is utilised. (1) To entirely produce the requisite flux in the magnetic system. (2) To reinforce the flux produced by other means, such as shunt coils. These conditions are attained practically by the use of a device by which it becomes practicable to fix the diameter of commutation of the armature in the necessary position relatively to the neutral diameter to produce this result. The device referred to, and the mode of its action, was described by the author in a paper read before the Institution of Electrical Engineers on May 11th last, and which will be found in No. 107, Vol. 22, of the *Proceedings* of that society.

The three-wire system being in use at Derby, it became necessary to provide against the disturbance produced by the loss of pressure in the so-called neutral wire when a current is flowing in it, owing to the two sides of the system being out of balance.

Mr. Sayers has constructed a diagram, fig. 1, which illustrates the




$E_1$ = fall of pressure in positive feeder = 200 × 0·05 = 10 volts; $E_2$ = fall of pressure in balancing feeder = 100 × 0·1 = 10 volts; $E_3$ = fall of pressure in negative feeder = 100 × 0·05 = 5 volts.

Fig. 1.

nature of this disturbance. In order to make it clearer, I have taken an extreme case, and supposed there to be double as much current flowing on one side as on the other, so that half the total current (200 amps.) is returning by the balancing wire which is supposed to have a cross section equal to one-half that of either of the outer feeders. Under these conditions if the feeders have the resistances indicated in the diagram, there will be a fall of 10 volts, both in the

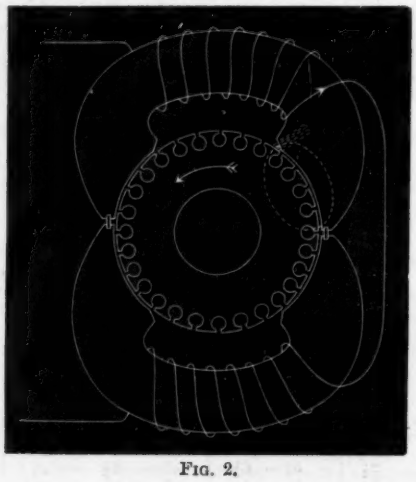


Fig. 2.

feeder and also in the balance wire as regards the overloaded side; but the fall of 10 volts in the balance wire counts as a rise of 10 volts as regards the underloaded side, and as the fall in the feeder on the underloaded side is only 5 volts, it is clear that the generator on the underloaded side must only give 95 volts in order that the pressure at the distant end shall be 100 volts, whereas, the generator on the overloaded side must give 120 volts to secure the normal of 100 volts at distant end. This disturbance, however, was compensated for by providing a winding on the keepers connected in series with a neutral wire, the winding being put on in such a way as to modify the amount of pressure added to, or subtracted from, the two sides of the system, so as to keep the pressure constant on both sides at the distant end of the feeders under all conditions.

On referring again to fig. 1, it will be seen that the compensator through which the current to the feeder on the overloaded side passes must raise the pressure 20 volts, while the compensator through which the current to the underloaded feeder passes must *lower* the pressure 5 volts. The main dynamos being kept at constant pressure of 100 volts. It, therefore, follows that the compensator must be capable of running sparklessly, not only when the magnetic induction through the armature and keepers is proportional to the current flowing, *i.e.*, the ordinary conditions of a series machine, but also when there is a current through the armature but no *effective* magnetic field or even a magnetic field in the opposite direction to what may be called the normal, so as to reduce the pressure. It so happens that the author's machines fulfil these conditions to an almost perfect degree. Fig. 2 represents a section through armature and keepers of one of the machines constructed. Suppose a current flowing through the winding around the keepers sufficient to neutralise or overbalance the effect of the current through the armature winding so far as the generation of E.M.F. is concerned, there will still be a considerable reversing field in the right direction due to the effect of the armature coils which are under the pole pieces, or what is known as the cross induction. This is indicated in one of the pole pieces by the dotted line. The position of the brush is also indicated by dotted lines.

Mr. Swinburne has pointed out to the author that with his device a motor can be designed having no winding whatever on the main moving part, which would be simply a mass of iron; this would involve the use of revolving brushes, but as there would be no necessity of shifting the diameter of commutation with varying load, there would be no objection whatever to this.

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### ELECTRICAL INTERFERENCE PHENOMENA SOMEWHAT ANALOGOUS TO NEWTON'S RINGS, BUT EXHIBITED BY WAVES IN WIRES.

By Edwin H. Barton, B.Sc., 1851 Exhibition Science Scholar.

(*Read before Section A, September 15th*, 1893.)

*Previous Work.*—Herr von Geitler,* while experimenting in 1892 with electrical waves passing along a pair of long parallel wires, noticed the following phenomena:—

If the wires at any part of their length were either—

1. Replaced by others thicker or thinner than the normal wires, as shown at A, fig. 1, or,

Fig. 1.—Changes which cause Reflexion.

2. Arranged nearer together or farther apart than their normal distance, as shown at B and C, fig. 1, then, in any of these cases, a partial reflexion of the electrical waves occurred at such place of change in the wires.

Von Geitler then made further observations of what occurred when a condenser was attached at a *single* point of each wire, as at D, D, fig. 1, but did not *quantitatively* examine the reflexions of the waves produced by the changes first named.

*Object.*—This I commenced to investigate. For, though it is easy to see theoretically that a change in the wires may produce a partial reflexion, it appeared interesting to ascertain if theory and experiment agreed quantitatively also.

In approaching this question, I assumed that the reflexion at the beginning of the altered, or let us say, the *abnormal* part of the wires—

1. Would be independent of the length of that abnormal part, and
2. Would depend only upon the difference between the abnormal and normal parts of the wires. But it very soon appeared that the matter was not so simple as might at first sight be imagined. For, not only have we to deal with the partial reflexion at the beginning of the abnormal part of the wires, but also with a second reflexion which occurs at the end of the abnormal part. I, therefore, expected that interference phenomena would occur, and that in consequence if the length of the abnormal part of the wires were gradually increased, the intensity of the transmitted waves would periodically increase and decrease. On account of their analogy to the optical phenomena of Newton's rings, these interference phenomena seemed specially noteworthy, and from this time constituted the chief object of the investigation. It will be seen that the length of the abnormal part of the wires corresponds to the thickness of the air film in Newton's rings, and that the reflexions at the beginning and end of the abnormal part correspond respectively to the reflexions at the first and second faces of the air film.

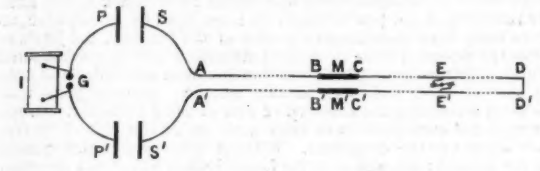
*Apparatus.*—The best arrangement which I have obtained for observing these interference phenomena is that diagrammatically represented in fig. 2.

In this figure, I represents the induction coil, which was worked by two secondary cells; G is the spark gap usually 2 mm.; P G P′ is the primary oscillator, and consists of two discs, P and P′, of zinc plate, 40 cm. diameter each, two copper wires, P G and G P′, each about

* *Wiedemann's Annalen*, Vol. 49, pp. 184—195, 1893, *Ueber Reflexion elektrischer Drahtwellen*, von J. Ritter von Geitler.

1 m. long and 2 mm. diameter, and the two brass balls between which the sparks pass across the gap, G. S S′ represent two discs of zinc plate precisely like P P′, and distant 30 cm. from them. From S S′ the long wires, S A D, S′ A′ D′, start, and along them the electrical waves, induced by the primary, P G P′, are propagated and reflected. B C, B′ C′ is the abnormal part of the wires used to produce the interference phenomena. At E E′ are short wires connecting to the discs of the electrometer.

Fig. 2.—Diagram of Apparatus.



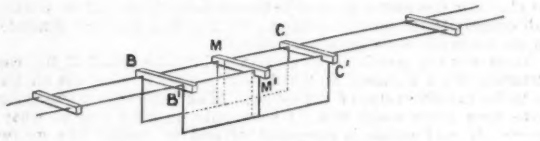




Fig. 3.—Abnormal Part of Wires.

The needle is uncharged, it therefore turns in the same direction whether E or E′ is positively charged and thus gives a deflexion, although the charges of E and E′ change sign in one sixty-millionth of a second ($\frac{1}{60000000}$th sec.) The spacing of the wires, *i.e.*, the distances, A A′ = D D′, was 8 cm., their diameter about 1 mm. The lengths were S A M = 101 m. and M D = 63 m. nearly, where M is the middle point of B C. E D was made a quarter-wave length, as this gives the maximum throw at the electrometer when the wires are joined at D D′, as shown.

*Results of Theory.*—Although the interference phenomena under consideration are essentially analogous to those of light in thin plates, yet the mathematical theory of the latter will not suffice for our case. Because, in the optical phenomena the amplitude of the incident light may be assumed constant, whereas in the electrical analogue the Hertzian primary oscillator emits waves, each of which is much feebler than its predecessor. It thus induces in the long wires a continually diminishing series of waves which advance along the wires in the form of a damped train with its large end leading. This train of waves may be represented by the following equation:*

$$y = \hat{a}\, e^{-\alpha t + a_1 x} \sin(\beta t - \beta_1 x) \qquad (1)$$

where $\alpha/\alpha_1 = \beta/\beta_1 = v$, the velocity of propagation.

I have already published an elementary mathematical theory† dealing with the interference phenomena of such a wave train. For experiments such as that hereafter described, the results of this theory are as follows.

(1.) For the single reflexion at the beginning of the abnormal part of the wires.

Let the amplitude of the incident wave be unity, that of the reflected wave, $b$, and that of the transmitted wave, $c$; then

$$b = -\frac{r-1}{r+1} \text{ and } c = \frac{2}{r+1} \qquad (2)$$

Where $r$ is the ratio of the capacity per unit length of the abnormal part of the wires to that of the normal part.

(2.) For the interference of the wave trains proceeding from the beginning and end of the abnormal part of the wires.

Let the energy of the wave train incident upon the abnormal part of the wires be unity, let $\tau$ be the total energy of all the waves transmitted along C, D, fig. 2, after one or more reflexions at C and B, and let $\rho$ be the total energy of all the waves returned along B, A, after one or more reflexions at C; then

$$\tau = \frac{1-b^2}{1+b^2} + \upsilon, \text{ and } \rho = \frac{2b^2}{1+b^2} - \upsilon \qquad (3)$$

where

$$\upsilon = \frac{1-b^2}{1+b^2} \cdot \frac{2b^2 e^{-\alpha t_2} \cdot (\alpha/\beta)\sin\beta t_2 + \cos\beta t_2 - b^2 e^{-\alpha t_2}}{1 - 2b^2 e^{-\alpha t_2}\cos\beta t_2 + b^4 e^{-2\alpha t_2}}$$

and $t_2$ is the time occupied by the waves in twice traversing the length, B, C, of the abnormal part of the wires.

From equations (3) we find that the lengths of the abnormal part of the wires, which make $\tau$ and $\rho$ maxima and minima, are precisely the same as in the analogous case of the interference of light in thin plates. Thus, for $\tau$, the first minimum occurs when the length of the abnormal part is one quarter wave length.

The values of these maxima and minima, however, differ from those obtained in the optical phenomena. For, whereas in the optical case the successive maxima and minima are respectively equal, in the electrical analogue the successive maxima and minima form a damped series and ultimately fade away to a common steady value. This is due to the fact that the train of waves passing along the wires is itself a damped one, as already expressed in equation (1) and referred to in the remarks immediately preceding it.

The nature of the function $\tau$, equation (3), is most readily seen from the curve, T, fig. 4, in which the lengths, B, C, of the abnormal part of the wires are plotted as abscissæ, and the intensities, $\tau$, of the transmitted waves as ordinates.

* V. Bjerknes, *Wied. Ann.*, Vol. 44, pp. 513—26.

† *Proc. Roy. Soc.*, pp. 85—96, read June 15th, 1893.

*Experiment.*—The interference phenomena may, of course, be obtained by any of the changes in the waves which produce reflexion. But the most striking method I have found is that of hanging sheets of tinfoil upon the conducting wires in order to form the abnormal part, B C. The phenomena are also conveniently obtained by putting the wires closer together for a certain length. But, in this case, the effects are much less marked. For, by this means, $r$ the ratio of the capacities, could not well be made greater than 2, which makes, $b$, the reflexion coefficient, equation (2), $= -0{\cdot}3$. Whereas with tinfoil sheets 32 cm. wide, $r$ was of the order 9, and $b$ consequently about $-0{\cdot}8$

In the experiment with the tinfoil sheets the electrometer was first read several times without any abnormal part, B C, fig. 2. One or more pairs of tinfoil sheets were then hung upon the wires and a couple of electrometer readings taken. The abnormal part, B C, was then lengthened about a metre by the addition of two pairs of sheets and the electrometer again twice read. This operation was repeated until the abnormal part, B C, had attained a considerable length. It was then in like manner shortened, readings being again taken as before. Thus in one experiment four readings were obtained for each metre's length of the part, B C. The experiment was performed four times, viz.: twice each with lengths, B C, of about

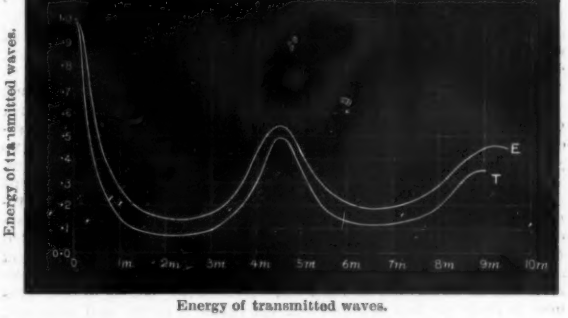
0, 0·5 m., 1·5 m, 2·5 m. ... ... 1·5 m., 0·5 m., 0
and 0, 1 m., 2 m., 3 m. ... ... 2 m., 1 m., 0
respectively.

Hence, in all, 8 readings were obtained for each half metre's length of B C. This large number of observations was made in order to eliminate the possible error due to the irregular working of the primary sparks which no precautions hitherto devised seem to entirely obviate.

The changes in the length, B C, were always made symmetrically so that its middle point, M, remained unshifted. This was done lest an alteration in the position of M might introduce a disturbing influence and so invalidate the electrometer readings.

The spacing of the wires was precisely the same in the abnormal part, B C, as in the other parts of the wires. The correct spacing was insured by accurately cut wood separators at each half metre along the abnormal part, B C, and at larger intervals along the normal parts of the wires, as shown in fig. 3. The successive sheets of tinfoil, each 50 cm. long, were allowed to overlap each other about 2 cms., were tightly clipped on to the brightly-polished wires and to each other by the wood separators, but being in simple contact with each other along their vertical edges. A very careful experimental comparison between an abnormal part so constructed, and 2·25 m. long with another of the same dimensions, but of zinc plates soldered together, showed that there was no appreciable difference in the fraction of incident wave energy which each transmitted.

The variation of transmitted intensities obtained with the tinfoil sheets is exhibited in the curve E, fig. 4. The intensity when no abnormal part is present being plotted as the unit ordinate and the lengths of B, C as abscissæ.




Energy of transmitted waves.

Fig. 4.

*Comparison of Theory and Experiment.*—In the experiment described the wave length was 9 m., $b$ was of the order $-0{\cdot}8$ and the logarithmic decrement* of the primary oscillations was experimentally found to be 0·5. These values inserted in equation (3) give as the curve of transmitted intensities that represented by T, fig. 4. The lengths of the abnormal part, B, C, are plotted as abscissæ, and the transmitted intensities as ordinates. It is seen that this curve lies wholly below the experimental one. The descrepancy between the two, however, is no greater than can be accounted for by a known disturbance which I have already measured, but have not yet succeeded in eliminating. The explanation of this, together with an account of other experiments, I hope to give in a future paper.

This work was carried out in the University of Bonn under the direction of Prof. Hertz, whose invaluable advice I have here much pleasure in acknowledging.

## ELECTRIC LIGHT—THERMAL STORAGE—UTILISATION OF TOWNS' REFUSE.

By Claude Chas. Keep.

(*Read before Section G, September 15th.*)

The increasing demand for electric light has been the means of bringing the question of the profitable disposal of refuse more prominently before the public during the last two years than at any previous time. Not a week passes without one or more of the

* Compare the values 0·5 and 0·4 found by V. Bjerknes, *Wied. Ann.*, Vol. 44, pp. 513—26, 1891.

technical journals containing articles on the subject of the title chosen for this paper. Reports on electric lighting schemes by the most eminent of our engineers usually refer to it: a few say it is possible, some that it is merely probable, others again that it is impossible, to combine the two. I hope to show that it is not only possible but practicable and economical to light cities and towns, in whole or in part, by burning the refuse accumulations. But without Mr. Halpin's system of thermal storage nothing of any magnitude can be done, as the disposal of the refuse must naturally proceed uniformly, and the demand for the electric light obviously varies during each moment of the 24 hours. Thermal storage may be described as the bank: it receives the continuous but irregular earnings of the destructor, and by its well-regulated system is able to pay on demand all it has received to its regular customers, meeting their varying requirements, only charging a small percentage for the accommodation it has provided.

I purpose first to deal with the refuse question, the disposal of which must be considered primarily from the standpoint of public health, and, secondly, from that of finance; and in order to help us to come to a conclusion it will be as well to say what towns' refuse consists of: Dust, ashes, wood, straw, paper, baskets, bricks, bottles, tin cans, old boots and shoes, brushes, oyster shells, old clothes, scraps of oilcloth and carpets, decaying food, dead dogs and cats, cinders, garbage, &c., collected from the markets (sometimes dry, frequently very wet); animals slaughtered when suffering from disease have also to be disposed of.

*Means of Disposal.*—By depositing in tips—such as disused sand and gravel pits, quarries—and filling up low-lying ground. *By storing* in a field, with a view to selling a portion during manurial season of the year. *By sorting* and sifting out the breeze cinders and fine ash (this operation is usually performed by women). I think neither of these methods of disposal can be said to comply with the requirements of public health, and in order to show that it is a failure financially, we have only to turn to the reports of the sanitary authorities. One I have in mind received £7,000 annually; it now has to pay double this amount to dispose of it in various "tips."

Destruction by fire completely complies with the requirements of public health, and destructors, if properly constructed and managed with ordinary care, can be erected in or quite close to cities and towns without causing the least complaint, and can be made a success financially. The late Mr. Alfred Fry invented the furnace known as "the destructor." He not only designed and patented this furnace, but coined the word "destructor," and registered it as a trade mark. His furnaces have been erected in between 40 to 50 different towns, and have successfully dealt with all descriptions of refuse, the midden contents—sewage sludge from precipitation tanks mixed with refuse, and with dust-bin contents, which is the easiest of all refuse to burn. I am aware other furnaces have been erected in a few towns, and unfortunately have been called by the same name. The essence of Mr. Fryer's patent is the sloping hearth and grate, and the arrangement for feeding or charging the furnaces at the back, and the clinkering or cleaning of the fires at the front. In this, everyone who attempts to erect furnaces for this purpose, and who have met with any degree of success, have copied Mr. Fryer's idea, only varying in some slight details. Reports have lately appeared in praise of some of these alterations, but older students of the subject will remember, 10 to 14 years ago, most of these arrangements were tried and abandoned—for one reason, they failed in their action owing to the character of the refuse at that time: it was collected at periods varying from once a month to once in 12 months, from deep middens, generally saturated with slops, urine, excreta, &c. The water-carriage system has disposed of this difficulty, but has left with us yet another—viz., the enormous cost for repairs of the furnaces. Those features of the furnaces most discussed at the present time are automatic feeding of the fires and forced draught. Automatic feeding will not be a success so long as refuse consists of the variety of material I have mentioned. It may be stated that one fire will need to be cleaned of the clinker, &c., and recharged in less than 20 minutes, while the next charge will take from one to two hours to burn off. Automatic feeding of the fires may be more or less successful if the refuse is sorted and screened, and only the cinders are burnt, but the cost of this screening operation makes it prohibitive (Sir Spencer Wells says the system is born of a spurious economy at the cost of human life), and the material most difficult to deal with is still left to be disposed of. It is perhaps not too much to say that more complaints are made about automatic stokers working ordinary furnaces than about any other class of machinery in this country, and these it must be noted, used screened and carefully selected coal. I believe the nearest approach to this object is to be found in Brodie and Boulnois's patent charging apparatus. I shall describe it in the words of the city engineer of Liverpool. The apparatus consists of a wrought-iron truck 5 feet in width by 3 feet in depth, and of such length as will cause it to be of sufficient capacity to hold not less than 12 hours' supply for the two cells which it commands. This truck moves along a pair of rails laid across the top of the destructor, and is capable of being worked by one man. The truck is divided into compartments holding a charge in each, and provided with a pair of doors in bottom opening downwards, which are supported by a series of small wheels running on a central rail. A special feeding opening in the reverberatory arch of the cell of the full width of the truck (5 feet), and placed immediately over the drying hearth, is constructed of a firebrick arch fitted into a frame capable of being moved backwards and forwards by means of a lever arrangement. The truck when empty is brought under the tipping platform, and the carts tip their contents directly into it; and when it is required to feed one of the cells, the truck is moved along so that one of the divisions is immediately above the feeding opening, and the wheel holding up the bottom doors rests upon the central rail, which is continued over the movable covering arch. Then the movable arch, actuated by the lever, is rolled back, releasing the doors and discharging the contents into the cell, so that no handling of the refuse is required from tipping to feeding. This arrangement provides portable storage for a large quantity of material, and entirely does away with the necessity for the shovelling and handling.

*Forced Draught.*—I find this was claimed in the original patent of Mr. Fryer. It has been applied in several places where the chimney has not been of the right design, and it has answered fairly well. At Birmingham steam jets have been in use several years, and extended tests have been made both with jets and fan blasts. The manager has come to the conclusion the best results are obtained by the latter. At Bradford, steam jets blowing into large pipes have been tried, and have lately been abandoned on several of the furnaces, and jets more after the design of those in use at Huddersfield have been substituted; while at Battersea the jets first used at Bradford were tried and failed to give as good results as natural draught. Another point much debated arises over the adoption of Jones's fume cremator. Grossly exaggerated statements have been made as to the cost of working this adjunct to the destructor. Without entering into this question at the present time, and as in the future boilers will almost invariably be placed in destructor flues, objections arising from cost of working fall entirely to the ground, owing to the fact that the heat generated by its use can be satisfactorily employed.

Time will not permit me to go further into the detail of the construction of the furnaces, so I will now proceed to give you an idea as to the calorific value of the refuse. Most extravagant statements have been made about this. I have only to refer you to what I previously said refuse is composed of, and to remind you no two cartloads contain exactly the same proportions. Statements have appeared professing to give the exact composition of London dust. If these statements were the result of a whole year's collection, one might look to them for guidance. It has also been stated in the public press that the calorific value of average refuse is equivalent to 4 lbs. of water evaporated per hour per 1 lb. of combustible matter in the refuse from and at 212° F., and it has also been stated elsewhere the same quantity of refuse will evaporate 0·01116 lb. of water from and at 212° F. The one amount exceeding the other 400 times! This great discrepancy is due to the total absence of any reliable and scientific information obtained by prolonged and accurate experiments. The better result referred to was, I believe, obtained by burning a few tons of refuse under exceptionally favourable conditions totally inapplicable to general use. There appears some reason for believing the lower figure is due to very inaccurate measurements. The collection of refuse is so arranged that the destructor receives the refuse of one particular portion of its district on one particular day of the week. Each portion of a district will probably give a distinctly different quality of refuse to that of its neighbouring portion, consequently the calorific value of the refuse collected on a Tuesday will vary from that collected on Wednesday, but the total heat generated by the destructor during one week will be very nearly equal to that generated in the following or preceding week. Hence, if the dust is collected weekly from dust bins, the week is the time in which the complete cycle of changes in temperature takes place in the destructor fires. The results that can be taken from one week's working are comparable to a single steam-engine indicator diagram. We all know the danger of deducing much from a single indicator diagram. Careful observers are not satisfied unless they take a number of such diagrams and deduce their results from the mean, because, under ordinary working conditions, the load varies throughout the day. Now, under normal conditions the work of the destructor varies from summer to winter, consequently, to obtain really reliable average data the result of one complete year's working must be acquired. Fortunately, the dust production and the electric light requirements vary in somewhat similar proportions during the summer and winter. The data of trials of the most recent type of destructors has not yet been completed, and, therefore, under the circumstances I may, perhaps, be excused for referring to trials of older destructors which have not been made generally public. At Birmingham the average evaporative power of 1 lb. of refuse has been found to be equal to the evaporation of 1·79 lb. water per hour. The refuse was burnt in furnaces of different types, and this result is the average of the whole burning during several years. At Warrington a different class of refuse has to be destroyed, where the evaporative power was found to be 1·47 lb. water per 1 lb. of refuse. I mention these two cases to indicate how great may be the difference in the calorific value of refuse collected in different towns, and it tends to prove that each town must be considered on its own merits.

I should like to draw attention to the preference some engineers at the present time are giving to complicated mechanical arrangements in the furnaces. I cannot emphasise too strongly that the design of furnaces for burning refuse should be of the utmost simplicity and durability. The stoppage of a town destructor on account of repairs or some trifling breakdown in the machinery, even for a few hours, completely disorganises the whole sanitary arrangements of a town, and when in addition to this drawback the power which would have been generated to produce electric light falls short, a whole district might be thrown into confusion. Destructors can and have been erected in such a way that they have never ceased work for seven years, day and night. It may therefore be concluded that such destructor would at all events not require greater stoppage than ordinary boilers in use in central electric lighting stations.

In concluding this portion of my paper, I wish it to be distinctly understood that destructors must work continuously day and night, and as, apart from the quality of the refuse, the heat production of the destructor is nearly uniform, but is not in the most utilisable form for the generation of steam for motive power to provide electricity; hence, owing to the irregular demand for the light, the necessity for the application of Mr. Druitt Halpin's system of thermal storage.

It has been attempted in some small degree to overcome the inconvenience arising from varying demand for electricity by using accumulators. Their heavy prime cost, great space occupied, their costly and rapid depreciation, their efficiency of only 80 per cent., form objectionable features that militate heavily against their general adoption. I must ask you to look for a moment at the lighting curve for electric lighting. The same applies to gas—if gasometers did not exist, the gas industry would be impossible, owing to its want of financial success due to the enormous number of retorts that would have to be used to provide for the maximum load, and to the fact that these retorts must be stopped and started exactly as the demand varies, thus causing them to be subjected to excessive wear and tear owing to the sudden heating and cooling, in addition to great fuel losses, and the labour of stoking being performed in a most uneconomical way. Before proceeding to further explain Mr. Druitt Halpin's system, I wish to call your attention to diagram No. 1; this represents the lighting curve for Kensington Court station. It is taken from Mr. Crompton's paper read before the Institution of Civil Engineers, and is an average curve for a mid-winter day. Engineers prefer to provide boiler power sufficient to meet the maximum demand. The extremely short period of this duty necessitates the laying by of the greater portion of the boiler plant for frequently two-thirds or even more of the 24 hours. Not only is this an objectionable practice on financial grounds, but the constant banking-up and re-lighting of boiler fires involves a heavy thermal loss, the magnitude of which has probably never been accurately estimated, in addition to great loss in efficiently utilising the labour of the stokers; moreover, the quality of the water supply must influence the life of the boiler, which, in an extensive boiler plant, will probably be found to affect dividends to an extent not yet contemplated. The conditions of a good electric lighting central station plant, therefore, involve the reduction of the boiler power to a minimum, and the omission of the present expensive accumulator system, combined with an ample supply of suitable boiler feed water. After studying for a considerable period the principles underlying Mr. Druitt Halpin's thermal storage system, of which so much has been said and written during the past year, I have come to the conclusion that these difficulties can be overcome by its adoption. By a fortunate combination of circumstances it is also peculiarly adapted to use with the destructor.

The system of thermal storage contemplates the working of a sufficient number of boilers during the whole 24 hours to produce the mean desired amount of steam and deliver the steam given off into reservoirs of suitable strength and capacity, containing sufficient water to store up part of the heat in the steam when the engines are working at a light load or when stopped to store up all the heat the boilers can produce. The boilers are preferably worked at a higher pressure than the engines, and the difference of pressure between the engines and the boilers is necessarily accompanied by a difference of temperature, and having a large mass of water available at this higher temperature really constitutes the source of the stored energy, thus justifying the application of the title of thermal storage to the system. It is well known that the majority of boilers are fed with more or less impure water, but in the thermal storage system the impurities are deposited in a place where they can do no harm, and the boilers are fed with clean water, thus avoiding incrustation, which entails expensive and imperfect cleaning, thus obviating the loss of fuel due to deposit, and reducing materially the wear and tear of the boilers.

Mr. Halpin's system may be carried out in whole or in part. *The first scheme* (*called steam storage*) contemplates the heating of such a volume of water during slack times by the excess steam, that this water will be able to provide the necessary excess of steam for the engines during heavy load, and thus to evaporate such portions of this water as the boilers are not able to cope with. It will be found that in this system the whole of the excess steam generated during the light load of 16½ hours can be utilised in heating the water and given back again in sufficient quantity during heavy load to enable the boilers to be worked uniformly throughout. A feature of this scheme is that a uniform continuous feed is contemplated. (It may be called *complete steam thermal storage.*)

*The second scheme* (*called feed storage*) is a means of providing the boilers with clean feed-water at the temperature of the steam in the boilers. The whole of the feed-water needed for evaporation during the 24 hours is pumped into storage tanks, and during the light-load period of, say, 16½ hours, it is raised to the temperature of evaporation by the excess steam generated during this light-load period. During heavy load the boiler can be supplied with feed-water at the temperature of the steam, but the fires have still to supply the heat necessary to produce evaporation—that is, to add the latent heat to the steam.

*The third scheme* (*called combined feed and steam storage*) is simply a combination of the first and second schemes, and differs only in the period of delivery and temperature of boiler feed-water. In this case, the whole of the feed-water is delivered into thermal storage reservoirs and heated during slack load to the required temperature of evaporation. This also is a complete thermal storage system.

As all these schemes must be reduced to figures to enable you to judge of their practicability, I will now take an instance of a district of the city of Edinburgh for which I have been enabled to obtain sufficient data. I am informed that the lighting curve before referred to may be assumed to represent that for this district without great inaccuracy.

Assume that feed storage tanks only be provided sufficient to hold the whole of the water required by the engines during the 7·1 hours heavy load, and that this volume is heated from 100° F. to 347° F. = 115 lbs., the pressure at which the engines are working during slack load. Without wearying you with all calculations (which I have given in detail in the appendix), it may be seen that with hot feed the boiler power can be reduced 22 per cent., and that this reduced boiler power will only have to work 4½ hours at full power, or the equivalent thereof, out of the 16·9 hours of light load. Owing to the reduction in boiler power the total prime cost of the plant with feed storage tanks is almost exactly the same as if boilers had been provided to do the whole work, and in addition to this the necessity for extra chimney that would be required by those boilers detached from the destructors entirely disappears. Working expenses of the plant with storage tanks should be considerably less, owing to the more regular duty which is imposed upon the boilers, and to the fact that incrustations will be absent in the boilers. As all the necessary heat is obtained from the refuse burned in the destructors, the whole of the fuel and labour of stoking otherwise required is obviously saved.

Secondly.—Assume the plant fitted up with thermal storage tanks and feed storage tanks on the lines of the third scheme. The boilers in this case are supposed to work at 250 lbs. pressure and capable of meeting the average load during the 24 hours, but experience has shown that the high pressure will not cause any difficulty either in the boilers or in the thermal storage reservoirs. You are no doubt aware that tanks 8 feet diameter × 30 feet long, working at 250 lbs. pressure, have been in use for some time for creosoting purposes. It is assumed the engines work, as before, at 115 lbs. pressure, and from the figures in the appendix it may be seen that the boiler power need only be one-third of that required if no thermal storage reservoirs were provided. Referring again to the figures in the appendix, it will be seen that even with an evaporative power of 1 lb. water to 1 lb. refuse, and allowing 40 lbs. water per kilowatt, that ample heat can be generated by the destructors by the burning of 80 tons per diem to supply the whole of the steam for such a central station.

I have shown that at Warrington the average evaporative power of the refuse throughout the year is 1·47 lb. of water per pound of refuse. My experience in this matter teaches me that it is unlikely the summer's evaporative power will be less than 1 lb. per 1 lb. of refuse; the equivalent figure during the winter month will probably approach 2 lbs. water per 1 lb. refuse, and hence you will notice I have based my calculations of the evaporative power on the assumption that summer refuse is supplied to the destructor throughout the year, but that the electric light is produced according to winter requirements. I may observe that at Liverpool the duty produced by the boilers in the winter is four times as great as that obtained in summer.

In concluding this paper, I may be allowed to express the hope that your patience has not been overtaxed. It will readily be admitted that the importance of the subject can scarcely be overestimated. The various opinions held by engineers are doubtless represented amongst my hearers, and though I can hardly hope to have succeeded in convincing all as to the position I have taken up, I do trust that in this direction something has been done. The subject I hope will be favoured with the best consideration and the most incisive criticism of all the sections, as it is only in this way the truth can be arrived at and thoroughly established.

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### APPENDIX.

The day of 24 hours may be divided into two periods—*i.e.*, period of slack load; period of heavy load. Period of slack load amount to 16·9 hours; period of heavy load amount to 7·1 (3.15 p.m. to about 10.20 p.m.). It is true that from 7.20 a.m. to about 9.40 a.m. the mean load is slightly exceeded, but, of course, so far as storage tanks are concerned, they must be provided for the *greatest excess load* only.

*Second Scheme* (*Feed Storage.*)—Let the storage tanks be sufficient to hold whole of water necessary for engines during 7·1 hours heavy load, and that this volume be heated from 100° F. to 347° F. during slack load. The boilers and engines work at 115 lbs. Now the maximum rate at which the power is required is 597·7 kilowatts, or about 800 E.H.P. The mean load on engines = 187·5 kilowatts, and for the given working conditions it may fairly be assumed that not more than 40 lbs. of water per hour per kilowatt will be consumed. Hence the average water consumption per hour should be 7,500 lbs. Total water used during 24 hours, 180,000 lbs.

*Note.*—Without storage tanks the maximum steam to be supplied by boilers (597·7 × 40 lbs. per hour = 23,908 lbs. per hour from 100° F. at 347° F.)

Maximum heat required = 23,908 (1,220 − 100) thermal units per hour = 26,778,000 thermal units.

Now with storage tanks delivering feed at 347° F.

Maximum heat required = 23,908 (1,220 − 347) thermal units per hour = 20,873,000 thermal units.

Hence if feed can be supplied at 347° F. the boiler powers can be reduced in ratio $\frac{20,873,000}{26,778,000} = 0{\cdot}7795$, or by 22 per cent.

Next, given storage tanks for heavy load, can 180,000 lbs. be heated from 100° F. to 347° F. during 16·9 hours slack load? By hypothesis the total boiler power is capable of furnishing 20,873,000 thermal units per hour.

During light load, 16·9 hours, the boilers have:

(1). To provide latent heat for engine steam.

(2). To raise 180,000 lbs. water from 100° F. to 347° F.

Area under curve during the light load = 0·973 square inch, length of base = 2·64 inches, therefore mean heat = $\frac{0{\cdot}973}{2{\cdot}64} = 0{\cdot}3686$ inch.

The scales are 1 inch = 6·3995 hours, and 1 inch = 247 kilowatts, or 9,880 lbs. water per hour.

Hence mean boiler duty during 16·9 hours = 0·3686 × 9,880 lbs. water per hour = 3,642 lbs. per hour, and total water, during light load = 3,642 × 16·9 = 61,550 lbs.

| | Thermal units. |
|---|---|
| Latent heat of evaporation of 61,550 lbs. at 347° F. = 61,550 × 873 thermal units ... ... ... | = 53,730,000 |
| Raising 180,000 lbs. 247° F. = 180,000 × 247° F. thermal units ... ... ... ... ... | = 44,464,000 |
| Total boiler duty during 16·9 hours light load in thermal units ... ... ... ... ... | 98,194,000 |

The boilers are capable of giving 20,873,000 thermal units per hour; hence, they will have to work $\frac{98,194,000}{20,873,000}$ hours = 4·70 hours at full power (or the equivalent thereof) during the 16·9 hours light load.

*Total Tank Capacity.*—Water to be stored = water of evaporation during 7·1 hours' heavy load.

Area enclosed between curve and base line during this 7·1 hours = 1·827 inch.

$$\text{Mean heat} = \frac{\text{area}}{\text{base}} = \frac{1·827}{1·11} = 1·6459 \text{ inch.}$$

1·6459 = (1·6459 × 9,880) lbs. water per hour = 16,262 lbs per hour.

Total water = (16,262 × 7·1) lbs. = 115,465 lbs.

Assume net capacity of one tank = 75,000 lbs., then number of tanks = $\frac{115,465}{75,000}$ = 1·54 tanks.

Allow 12 per cent. for water expansion 0·2 tank.

Total tanks required = 1·54 tanks, say 1·75 tanks.

*Relative Cost of Boiler Scheme with and without Storage.*—Without storage, boilers must be capable of evaporating from 100° F. at 347° F. 23.908 lbs. per hour, and must be capable of yielding about 800 E.H.P. Assuming cost of water-tube boilers to be £3 per electrical horse-power, then cost of boilers = £2,400.

| | |
|---|---|
| We have seen that with storage the boilers may be reduced 22 per cent., hence cost is then ... ... | £1,872 |
| Allowing £500 for each tank, 500 × 175 ... ... | 875 |
| Total cost ... ... ... | £2,747 |

For a small scheme such as this, the difference in first cost is not great, and in large schemes difference is in favour of thermal storage system.

*Third System* (*Complete Thermal Storage and Feed Storage*).—Boilers work at 250 lbs., and are sufficient for average load only. Whole feed is supplied during light load, and the storage water at 406° F. is sufficient to contain heat for latent heat of evaporation for excess steam during heavy load.

Available range of temperature, 59° F.

Engines work at 115 lbs., or 347° F.

Boiler duty during light load comprises:

1. Heating of 180,000 lbs. water from 100° F. to 347° F. (feed).
2. Heating storage-tank water from 347° F. to 406° F.
3. Evaporating 44,349 lbs. water at 347° F., being water required during light load for engines.

The excess steam to be evaporated by storage-tank water is shown on diagram enclosed between red curve and mean height line.

This area in all = 0·66 square inch = 41,735 lbs. water to be evaporated at 347° F.

Total heat required = 41,735 × 873 thermal units.

Storage water in tanks = 41,735 × 873 lbs. = 617,500 lbs.

(Storage water only falls 59° F. in temperature.)

Number of tanks required for steam water storage

$$= \frac{617,500}{75,000} = 8·23$$

Allowing 12 per cent. for water expansion, about 9 tanks are required. For feed-water storage we have seen about 1·75 tanks are required.

About 11 tanks in all are necessary.

Returning to boiler duty during light load:—

| | | Thermal units. |
|---|---|---|
| (1) | 180,000 × 247 thermal units | = 44,462,000 |
| (2) | 617,500 × 59 ,, ,, | = 36,438,000 |
| (3) | 44,349 × 873 ,, ,, | = 38,712,000 |
| | | 119,612,000 |

average boiler duty = 8,981,000 thermal units per hour.

$$\frac{119,612,000}{8,981,000} = 13·32 \text{ hours.}$$

9·395 (heavy load period).

22·715 hours.

During the 24 hours the boilers work at full power for 22·7 hours.

In this scheme the boilers are proportioned to give 187·5 kilowatts, or about 250 E.H.P.

*Costs of this Scheme.*

| | |
|---|---|
| Eleven storage tanks at £600 each, to stand 250 lbs. per square inch, and to contain 75,000 lbs. water | £6,600 |
| Boilers to give 250 E.H.P. at £3 per E.H.P., plus 5 per cent. for extra pressure ... ... ... | 850 |
| | £7,450 |

## GERMAN ELECTRICAL ENGINEERS' UNION.

In January last there was formed, with a membership of 34, the German Electrical Engineers' Union. This now includes 762 members, and the first annual meeting has been held at Cologne on September 27th, 28th, 29th, and 30th, when papers were read and works were visited. Dr. Slaby, the President of the Union, presided over the meeting, and was re-elected to the same post. The vice-presidents are Herr Wilhelm von Siemens and Herr Rathenau.

The first paper read was one by Herr Polak, on "Charging Accumulators by means of Alternating Currents." He had devised an apparatus for changing alternating into continuous currents, and had obtained with it an efficiency of 98 per cent. This, he believed, would be found of much use in the working of electric tramways and railways. The apparatus could likewise be utilised in converting continuous into alternating current. An opportunity was subsequently afforded of seeing this in operation. A paper on "The Thomson Electric Welding Process" was read by Herr Ross, and the plant was also seen at work. Dr. Budde followed with a paper on "The Chicago Electrical Congress," which dealt more particularly with the question of the official fixing of the units. A paper was read by Herr Ross on the Lagrange and Hoho electrical process of heating metals for welding and allied purposes, which is applicable to even very refractory metals. This process was shown to the members at Herr Hagen's Kalk Accumulator Works. A system of measurement for central electricity stations was dealt with by Herr Kallmann, and, on the motion of Herr Voigt, it was determined to appoint a committee for the consideration of the formation of a standard for screws and contacts used for switches, safety apparatus, and so on. This committee will report on its labours at the annual meeting next year. A paper was read by Dr. C. Heim on "A Portable Testing Apparatus for finding the Insulation Resistance of the Non-Conducting Material surrounding Conductors." The meetings terminated with some festive gatherings. Leipzig is the town selected for next year's visit.

## THE CHAMBER OF DELEGATES AT CHICAGO.

The Congress of Electricians at Chicago has been in many ways a great success. It would be impossible here to give anything like a full summary of the work of the various sections. The presence of Prof. von Helmholtz gave a special interest to the gathering; for, as pointed out by Prof. Elihu Thomson, he is a man whose work has gone to make many of the sciences what they are—it would be difficult to say whether in optics, in sound, in electricity, in the laws of motion, or the conservation of energy, he had done most work. An optical congress might claim him; a congress of music and sound might claim him; and a congress of electricians did claim him. Prof. Ayrton's address was characteristically piquant; he stated very clearly his opinion of the exhibits, and though there were some features of American electrical work which he could not praise, he spoke in high favour of their many estimable qualities, and he was clearly impressed with their general spirit of enterprise. The work of the sections will best be appreciated by reading the papers as they appear in the Press. An excellent *précis* of their doings is given in the N.Y. *Electrical World* for September 2nd. The report of the Chamber of Delegates represents the more solid part of the work before the Congress. The first question which came before the Chamber of Delegates was the adoption of values of the units of resistance, current and E.M.F. The following resolutions upon these points have been passed by them:—1. Resolved: That the several Governments represented by the delegates of this International Congress of Electricians be, and they are hereby, recommended to formally adopt as legal units of electrical measure the following:—As a unit of resistance the international ohm, which is based upon the ohm equal to $10^9$ units of resistance of the C.G.S. system of electro-magnetic units, and is represented by the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14·4521 grammes in mass, of a constant cross-sectional area, and of the length of 106·3 centimetres.

As a unit of current, the international ampère, which is one-tenth of the unit of current of the C.G.S. system of electro-magnetic units, and which is represented sufficiently well for practical use by the unvarying current which, when passed through a solution of nitrate of silver in water, and in accordance with accompanying specifications, deposits silver at the rate of 0·001118 of a gramme per second.

As a unit of electromotive force, the international volt, which is the electromotive force that, steadily applied to a conductor whose resistance is 1 international ohm, will produce a current of 1 international ampère, and which is represented sufficiently well for practical use by $\frac{1000}{1434}$ of the electromotive force between the electrodes of the voltaic cell known as Clark's cell, at a temperature of 15° C., and prepared in the manner described in the accompanying specification.

As a unit of quantity, the international coulomb, which is a quantity of electricity transferred by a current of 1 international ampère in one second.

As a unit of capacity, the capacity of a conductor charged to a potential of 1 international volt by 1 international coulomb of electricity.

As a unit of work, the joule, which is $10^7$ units of work in a C.G.S. system, and which is represented sufficiently well for practical use by the energy expended in one second by an international ohm.

As a unit of power, the international watt, which is equal to $10^7$ units of power in the C.G.S. system, and which is represented sufficiently well for practical use by the work done at the rate of 1 joule per second.

As the unit of induction, the henry, which is the induction in the circuit when the electromotive force induced in this circuit is 1 international volt, while the inducing current varies at the rate of 1 ampère per second.

The committee appointed to consider the standard of light beg to present the following report:—They have had much discussion upon the various forms suggested for practical standards, and in particular upon the two forms of lamps known and represented as the amyl-acetate lamp of Von Hefner-Alteneck and the pentane lamp of Vernon Harcourt. The only practical lamp actually presented to the committee is the new Von Hefner lamp, which, although it has been laboriously tested at the Reichsanstalt and reported accurate to within 2 per cent., has not received any extended trial in other lands. That, thereafter, it was reported that the pentane lamp in its recent improved form was preferred in England for the photometry of gas-lights. There is the objection to the pentane lamp that the composition of the commercial pentane is not sufficiently well defined; and to the amyl-acetate lamp that its colour is too red in hue; finally the objection to all open flame lamps is that they are too liable to be influenced by the changes in the pressure and temperature and moisture of the air. It is admitted on the other hand that no electrical lamp suitable for use as a convenient practical standard has yet been realised. Under these circumstances there was a sharp division in the committee between those who advocated the Von Hefner lamp as an independent standard, and those who desired to maintain *statu quo* until further researches should have been made in various countries.

It was proposed by Drs. Budde and Lummer, that the Hefner lamp, constructed exactly according to the specifications of Mr. Von Hefner-Alteneck, be introduced as a provisional practical standard of light, and that the problem of determining its value in terms of an absolute unit be left to subsequent investigation. On vote, this was lost by two votes for, and four votes against. The following motion, proposed by Messrs. Palaz and Thompson, and amended by Drs. Budde and Lummer, was then carried unanimously:

Resolved: That this committee, while recognising the great progress realised in the standard lamp of Von Hefner-Alteneck, and from important researches made at the Reichsanstalt, and also recognising that other standards have been proposed and are now being tried, and that there are serious objections to every kind of standard in which an open flame is employed, it is therefore unable to recommend the adoption, at the present time, of either the Von Hefner lamp or the pentane lamp, but recommends that all nations be invited to make researches, in common, on well defined practical standards, and on a convenient realisation of an absolute unit.

J. Violle, A. Palaz,
Edw. L. Nichols, Silvanus P. Thompson.

The table of symbols and abbreviations recommended by the sub-committee of the delegates, and received by the chamber of delegates, without, however, being adopted by them, is, with but few changes, like the original proposition of Mr. Hospitalier. The changes in it are briefly about as follows:—The Roman letters in the second, third and fourth columns, should be italics; acceleration is to be represented by $a$ instead of A; both small letters and caps are to be used as symbols of force, resistance, electromotive force, current, quantity and capacity; for difference of potential, U and $u$ are to be employed; for resistivity, $\rho$; conductance, G; conductivity (specific), $\gamma$; the subscript, s, is to be omitted in the symbol for the coefficient of induction; the letter $m$ in the formula for the intensity of magnetisation is changed to the capital, as in the line above it; the symbol for resistivity is changed to $\rho$, the abbreviation for force is to be followed by an asterisk, to distinguish it from mass; $o$ for ohm is changed to "ohm," to distinguish it from zero. The quantities "moment of a couple" and "coefficient of mutual induction" are erased.

## NEW PATENTS—1893.

17,501. "Improvements in and connected with alarum clocks, and electrical signalling appliances." W. Fielder. Dated September 18th.

17,521. "An improved method of illuminating by the electric arc." J. Jackson and W. Dixon. Dated September 18th.

17,526. "Improvements in or relating to fac-simile telegraphy." R. J. Crowley and H. W. C. Cox. Dated September 18th.

17,557. "Improvements in electric meters." E. Commelin. Dated September 18th.

17,564. "Improvements in electric accumulators." A. Koch. Dated September 18th. (*Complete.*)

17,603. "Arc lamp." A. S. Atwater. Dated September 19th. (*Complete.*)

17,605. "Improvements in dynamos and dynamo motors." W. S. Freeman. Dated September 19th.

17,618. "Improvements in electric meters." C. Ebben and E. Bergmann. Dated September 19th.

17,631. "Improvements in and connected with alarm clocks and electric sound signalling appliances." H. Newmarch. Dated September 19th.

17,645. "Improvements relating to the distribution and regulation of electric current." H. H. Grenfell and O. March. Dated September 19th.

17,646. "Improvements in telephone switch operating mechanism." T. W. Ness. Dated September 19th. (*Complete.*)

17,658. "Improvements in current conveyers for electric railways." R. W. Barker. (Communicated by the Lawrence Electric Company, United States.) Dated September 19th. (*Complete.*)

17,666. "Lithophanique porcelain shades for the electric light." W. I. G. Lewis and E. J. Bradley. Dated September 20th.

17,690. "In or relating to the transmission of electricity and sound along a conductor without a return circuit, and a means of reducing electrical resistance in the air, earth, or sea." R. J. Crowley. Dated September 20th.

17,692. "An electric match." E. Coustau. Dated September 20th.

17,729. "An improved convertible combination lamp for electric light, gas, oil, or candle fittings for general advertising." A. Kelvie. Dated September 20th.

17,735. "Improvements in the construction of electric appliances applicable to corsets." J. A. McNaughton. Dated September 21st.

17,796. "Improvements in electric arc lamp regulators." R. Kennedy. Dated September 22nd.

17,804. "Improvements in or connected with secondary batteries." F. L. Berners and J. L. Higgs. Dated September 22nd.

17,830. "A new and improved galvanic battery to be called a cartridge-shell battery." G. Abbott. (Communicated by J. J. Pearson, United States.) Dated September 22nd.

17,850. "Improvements in electrically propelled vehicles." E. J. Clubbe and A. W. Southey. Dated September 22nd.

17,866. "An improved manufacture of electric accumulators." L. W. Schoffer and G. E. W. Schoffer. Dated September 22nd.

17,867. "Improvements in apparatus for the electrolytical decomposition of brine and other liquids." H. Guthrie and M. Guthrie. Dated September 22nd.

17,874. "Improvements in globe holders for gas, oil, or electrical purposes." H. Walker. Dated September 23rd.

17,933. "Automatic supply fuse for electric supply currents, and in apparatus connected therewith." J. Hopwood. Dated September 23rd.

## ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1892.

1,243. "Improvements in magnetic compasses for use by night (on horseback)." J. J. Steward. Dated January 22nd. The compass box is made in an improved way with two flat pieces of glass placed above and below the needle; one of the pieces of glass is painted with either degrees or points, or both degrees and points. The top glass is protected by a hinged cover, and the bottom glass by a cover to remove by unscrewing or other convenient means. 5 claims.

1,656. "Improvements in electric brakes." J. Y. Johnson. (Communicated from abroad by A. de Bovet, of Paris.) Dated January 27th. There is fixed upon the axle a magnetic wheel or pulley having a quantity of wire coiled in its interior in such a manner, that when a current is caused to flow in the wire the two rims or flanges of the pulley act as the poles of an electro-magnet. A suitable number of wedge-shaped iron blocks or shoes attached to a flexible band or strap engage with the groove formed between the rims or flanges of the pulley, and when the strap is contracted close the magnetic circuit formed in the pulley by the action of the current. The extremities of the strap are connected to the frame of the vehicle by a combination of jointed rods or links, so arranged as to compensate for the action of the springs, and enable the blocks to act upon the greater part of the periphery of the pulley when the latter is rotating in either direction, the blocks being caused to press upon the pulley by the magnetic attraction of the latter, with a force proportionate to the intensity of the current circulating in the coils and the rigidity of the encircling band or strap. 6 claims.

2,365. "Improvements in electrical communicating apparatus for mines and other places." A. F. Mabon. Dated February 8th. The inventor has the conductor or conductors connected to switch or contact mechanism, contrived so that a pull applied to any part of the conductor or conductors will make or break contact in a manner to cause the transmission of a signal to the station from which the conductor or conductors extend. 3 claims.

13,297. "Improvements in electropathic appliances for human wear." W. W. Horn. (A communication from R. S. Mears and W. C. Powers, both of America.) Dated July 20th. Consists of a suitable cell or casing containing a galvanic pile and having binding screws upon the upper case of the said cell. 6 claims.

13,702. "A telephonic system for the transmission of news." T. Puskas. Dated July 27th. An official placed in the editor's office of the telephonic news transmitting system speaks from the text of the news before him into a telephone transmitter which by means of special devices, and opening up the necessary connections, will transmit the news through the line to the subscriber, so that the news will be reproduced at every station on the entire system. 4 claims.

14,181. "Improvements in or connected with electric batteries." C. P. Shrewsbury and J. L. Dobell. Dated August 5th. Relates to that class of electric battery in which one electrode is formed by

plates or slabs of carbon or coke, or other carbonaceous matter, and in which the other electrode is formed of surfaces of iron or other metal, or of a suitable metallic oxide, the exciting liquid being nitrate of potash, nitrate of soda, or any other suitable nitrate maintained in a fused state by the aid of heat; air, nitric acid vapour, oxygen, ozone, nitrogen pentoxide, or other suitable oxidising vapours or gases, either alone or in combination, being introduced into the fused nitrate in order to recuperate the same. 4 claims.

16,124. "Improvements relating to telephonic switching apparatus." A. R. BENNETT. Dated September 8th. The chief feature of the invention consists in joining the signal apparatus used for notifying to the operator the termination of a conversation to only one of the conductors of the flexible connecting cords used at the exchange for joining subscribers' loops, whereas in a previous specification there is described an arrangement wherein the two conductors of the flexible connecting cord are joined by a bridge wire, the middle point of which is joined to the said signal apparatus. 6 claims.

18,025. "Improvements in and relating to electric elevators." A. B. SEE and W. L. TYLER. (Under International Convention.) Dated March 14th. Consists, in general, of the combination with a wheel or switch-arm operated from the car of a pole-changer and circuit controller operated in succession thereby, and an electro-magnetic apparatus controlling the motor circuit, and itself controlled by the said circuit controller.

19,061. "Electric railway system." W. E. IRISH. Dated October 24th. The object of the invention is to provide means for thoroughly insulating the conductors, protecting them from coming in contact with persons or animals, and for employing the electrical energy economically and efficiently. 6 claims.

18,077. "Improvements in electric switches." H. T. PAISTE. Dated October 10th. The object of the invention is to construct an electric switch that will quickly make and break a circuit, and in which the handle can be turned in one direction at any speed, while the switch proper will make or break the circuit almost instantaneously. 4 claims.

18,142. "Improvements in and relating to conduits, conductors, and collectors for electric railways." R. BOOTH. Dated October 11th. Consists essentially of an electrical conducting strip or bar, embedded or encased hermetically in a partially or wholly flexible tube or casing or series of tubes or casings of insulating material, and a series of protruding flexible contact strips, normally held apart from the conducting strip, but susceptible to contact therewith by the agency of the determined pressure exerted by a spring trolley or current conveying device attached to vehicle to be moved. The said encased conducting strip and contact strips, which form the main conductor, being "armoured" with suitable strips and secured in a substantial support of iron, concrete, or suitable material. 5 claims.

18,516. "Improvements in and relating to the electro-deposition of metals." E. N. A. PICARD and J. A. TANIERE. Dated October 15th. Consists in subjecting the metal being deposited by electrolysis to a beating or hammering operation. 4 claims.

18,538. "A new constructionof underground conduits for electric conductors." T. WALLACE. Dated October 17th. The conduits constructed according to this invention mainly consist of continuous passages, preferably of rectangular section, having their sides, bottom, and top formed, in position, of asphalte, concrete, or other suitable material, but preferably of a concrete composition of Portland cement. The top of the conduit may be formed partially of wood or iron. 4 claims.

19,146. "Improvements in insulators for electrical and other purposes." H. H. LAKE. (Communicated from abroad by Johns-Pratt Company, of America.) Dated October 25th. Consists in an insulator, the insulative portions of which are made from mica. 11 claims.

19,160. "Improvements in or connected with telephone receivers." W. P. THOMPSON. (A communication by G. V. Benjamin, of New York.) Dated October 25th. Relates to a telephone receiver provided with an ear embracing cap or cover, and to a combination of such devices for supporting elastic conductors connected with a receiver or receivers. 8 claims.

19,602. "Improvements in electric switches." A. B. BLACKBURN. Dated November 1st. In an electric switch, purchase is obtained, for the fingers to operate it, by means of two handles which are brought closer together on being pressed, and on being released are separated by means of a spring acting between them, or by the force of gravity. 1 claim.

19,655. "Improvements in and relating to a method of and means for heating by electricity." H. G. O'NEILL. Dated November 1st. More particularly relates to a mode or process of supplying a number of storage heaters with electricity from a single current, by intermutation, or rapid successive distributions of the current in full force in succession to the various storage heaters, but intermittently to each heater, the current being diverted or cut off from all heaters of the set but one during its momentary application thereto in turn; and to the means employed for carrying out such mode or process. 4 claims.

19,671. "Improvements in means for conducting electricity for electric lighting and other purposes." M. W. POLLARD. Dated November 1st. Consists in depositing upon glass a line of silver, gold, platinum, or other metal in powdered form, and then heating the glass sufficiently to cause the metal to adhere to it, the line of minute particulars thus united with or embedded in the surface of the glass will form a conductor for the electric current. 6 claims.

19,768. "Improvements in thermometers for closing electric circuits for alarm and other purposes." E. WESTBROOKE. Dated November 3rd. The contact by which the circuit is closed when the minimum temperature is attained is made adjustable, so that its position can be varied to suit different requirements.

19,927. "Improved means for lighting railway cars by electricity." J. KORNER. Dated November 5th. Consists, broadly, in providing each car with a dynamo-electric machine or generator of its own, and a working circuit into which an electrical lamp or lamps are connected. The dynamo-electric machine or generator in each car is driven by compressed air, the said air being supplied from an air pump, preferably mounted on the locomotive and driven by the engine. From the said air pump, a main pipe, fitted with suitable valves, feeds the compressed air to a motor of any suitable construction, and said motor, being worked by the compressed air, imparts motion to the dynamo-electric machine or generator. 1 claim.

20,606. "Improvements in electric arc lamps." C. A. DAY. (A communication from the Higham Electric Company, of America.) Dated November 15th. The object of the invention is to provide means whereby the feeding of the carbon of an arc lamp in a circuit will not materially affect the current supplied to the other arc lamps in the same circuit. 5 claims.

20,621. "Improvements in electric burglar alarms." H. T. WILSON and N. SCHWAB. Dated November 15th. Has for its object to provide an alarm bell of peculiar construction, a single source of energy, and an open and a closed circuit, whereby the opening or breaking of the closed circuit will cause the bell armature to fall back and close the open circuit through a vibrator spring. 1 claim.

20,693. "Improvements in electric arc lamps." F. HANSEN. Dated November 15th. There is used in conjunction with a pivoted electro magnet a chain wheel, around which the chain or other suitable connection carrying the carbon holders runs. This chain wheel is mounted to oscillate with the electro-magnet, but is so connected therewith, that the point of its circumference, where the chain carrying the upper carbon holder runs off, lies exactly in the axis of oscillation of the electro-magnet, so that during the oscillatory regulating movement of the electro-magnet with the chain wheel, the said point, and consequently the carbon suspended therefrom, will remain stationary, and only the opposite part of the chain or connection carrying the lower carbon holder will be moved according to requirement, so that the regulation of the arc will be effected by the movement of the lower carbon alone. 6 claims.

20,864. "Improvements in telephone receivers." R. POLLITZ. Dated November 17th. Relates to a new or improved appliance adaptable to telephones for rendering the sounds emitted thereby more audible, and protecting the ear of the user thereof. 1 claim.

20,894. "Improvements in and relating to telegraphic or telephonic call systems. H. WETZER. Dated November 17th. Relates to any electric circuit comprising a number of stations and one or more calling stations, from which calls are to be sent to any one of the aforesaid stations, and it consists in certain apparatus whereby from any of the calling stations signal may be made at any one of the receiving stations. 6 claims.

20,989. "Detachable electric light bracket." A. W. UPCRAFT. Dated November 18th. Consists of a movable bracket particularly suited for outside window lighting, or any purpose where it is desirable to make electric contact in a detachable bracket or electrolier. 1 claim.

21,268. "Improvements relating to suspension devices, chiefly designed for electric incandescent lamps." S. PORTER and J. R. WHITE. Dated November 22nd. Consists as a whole in a spool or reel, adapted to be engaged with the flexible support, so that, when rotated in one direction, it will accumulate portions of the support upon its periphery; and, when rotated in the opposite direction, will give out portions of the flexible support from its periphery; means for automatically rotating said spool, to cause it to wind up or accumulate the flexible support; and a frictional brake or retarding device which is separable from the flexible support, and is adapted to act on the same in such manner as that the weight of the article suspended will prevent the rotation of the spool when the article is allowed to hang in its natural position and act by gravitation on the support, the arrangement being such that a movement or change of position of the retarding device will separate it from the support and thus remove the friction therefrom and allow the spool to take up or give out any desired portion of the same, thus adjusting the article suspended by the support. 2 claims.

21,273. "Improvements in electric contact breakers, applicable to motors, clocks, or the like." M. VAN BUREN ETHRIDGE. Dated November 22nd. Consists mainly in an improved electro-mechanical motor, comprising an electric circuit including an electro-magnet, a pivoted lever adapted to be oscillated and provided with means for imparting a step by step movement to a clock mechanism, a circuit closing and breaking device operated by oscillating movements of said lever, and consisting of, first, a loose weight adapted to be moved independently on said lever by gravitation, and, secondly, two electrodes supported by the lever and arranged to be alternately separated and connected by movements of the weight, said electrodes being included in the electric circuit, and means controlled by the electro-magnet, whereby a movement in one direction is imparted to said lever when the circuit is closed, and in the opposite direction when the circuit is broken. 7 claims.

21,621. "Improvements in and in the manufacture of incandescent electric lamps." D. VON MITO. Dated November 26th. A characteristic feature of the invention is that the platinum wire serves only for conveying the electric current through the glass, and is not employed either for securing the carbon filament nor the conducting wires; the electric contact inside the bulb, as well as outside the same, is effected by means of a tin-copper alloy. 6 claims.

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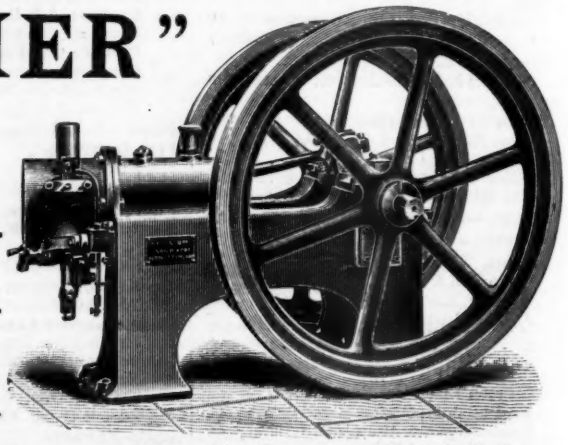

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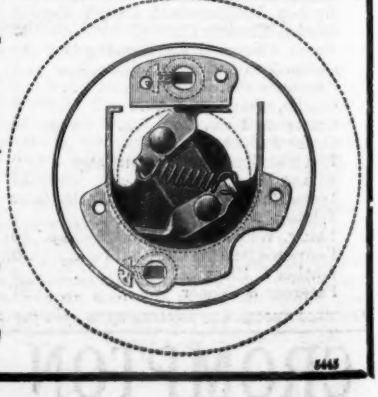

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